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CONTENTS.

Editorial 395
The Institute Nominations 398
International Electrical Congress of St. Louis..... 398
Chicago Drainage Canal Power Offered for Sale..... 398
A Successful Apprentice School in an Electrical Factory..... 399
Printing Telegraph 399
Induction Motors for Traction..... 400
Single-Phase Induction Motor 400
Current News and Notes 401
Electrical Engineers of the Times.—XLVII. W. H. Merrill, Jr.... 404
The District Supply System of the North Shore Electric Company near Chicago 405
The Reincarnation of an Electrical Idea. By Frank J. Sprague.... 407
The Magnetism in Induction Motors. By H. F. and H. W. Connell 408
The Economy of Steam Turbines Compared with That of Reciprocating Engines. By T. Stevens and H. M. Hobart..... 410
The Testing Room of the Worcester Electric Light Company..... 413
The Lighting Problem in Residence Streets. By H. S. Knowlton.. 414
Letter to the Editors:
Weight of Single-Phase Motors. By Bela Valatin..... 415
Digest of Current Electrical Literature..... 415
Book Review..... 419
Electrical Equipment of the Louisville & Nashville R. R. Shops.... 419
Turn-Down Incandescent Lamp 420
Applications of Jenney Electric Motor..... 421
High-Pressure Fire Pumping in New York City..... 421
"Liliput" and "Economy" Arc Lamps..... 422
Barriett Direct-Current Motors 422
The Wire and Telephone Company of America..... 423
Current Indicator for Spark Coils..... 423
Industrial and Commercial News..... 424
General News 427
Weekly Record of Patents..... 436

The Gas "Arc."

From all over the country come reports of the successful meeting by Nernst lamps of the stiff competition put up by so-called gas "arcs" for commercial lighting. That the competition of this type of gas burner with electric illuminants is severe in the majority of places cannot be denied, and it has perhaps been most keenly felt where the gas "arc" has come into direct competition with alternating-current arcs. As is well known, both of these sources are deficient with respect to the proportion of total light thrown downward at angles below 60 degs. from the vertical. It is just at this point that the Nernst lamp comes in with its large percentage of downward illumination. That the burner does make a good showing when comparisons are made on the basis of mean spherical candle-power cannot be denied, but the defect noted has been its undoing, except where electric rates are very high and gas rates very low, when brought into competition with Nernst or high-efficiency incandescent lighting units properly placed and equipped with reflectors. It appears to be the general experience that one 3-glower Nernst lamp taking 264 watts is able in commercial practice to replace the ordinary four-burner gas "arc" lamp; and this is confirmed by some recent tests which show that the useful light from a three-glower Nernst is about the same as that from a four-burner gas "arc." Assuming the Nernst lamp to be supplied with electrical energy at 10 cents per kw-hour, the cost of operating the three-glower, 264-watt Nernst lamp would be 2.6 cents per hour. Four-burner gas lamps when burning at an efficiency making them comparable with three-glower Nernst lamps, consume in the neighborhood of 20 cu. ft. of gas per hour, making a cost of 2.5 cents per lamp-hour, with gas at $1.25 per thousand cu. ft. With the cost to the user approximately the same, the electric light naturally has always the preference.

The Distribution of Magnetic Flux in Induction Motors.

The article by Messrs. H. F. and H. W. Connell appearing on page 408 of this issue emphasizes and supports the now generally accepted belief that the flux distribution in an induction motor is sinusoidal, both as to electrical time value and as to electrical space distribution, unless the impressed e.m.f. differs appreciably from a sine wave in form. From the earliest days of the construction and theoretical analysis of the induction motor there have been some who maintained that the magnetic flux in the motor could not be sinusoidal, even when the impressed e.m.f. was sinusoidal and the windings of the motor were completely distributed. But experimental investigation has, we believe, always negatived this proposition. That is to say, the numerous experiments that have been made during the last fifteen years on induction motors indicate that the flux tends to have a sine-wave form of space distribution, unless the magnetic surfaces are very polar, or the impressed e.m.f. is kinky. Of course, this is a fortunate condition of affairs from all standpoints, because it simplifies everything connected with the analysis of actions in the induction motor. If we accept the doctrine supported by the experiments described in the article, we find that

the conclusion is in line with the great generalization that Nature loves simplicity; or, that although the complex organism or organization may survive in competition with the simpler, yet the unnecessarily complex organism or organization tends to be suppressed. One form of this generalization in dynamics is called the principle of least action, enunciated by Hamilton.

Multitudes of examples of the tendency of waves to the sinusoidal form are presented to our view. A storm on the ocean raises within its sphere of influence waves of every imaginable degree of complexity in outline, which spread out and radiate for hundreds of miles in all directions. In the end, these waves, as ocean swell, follow a simple sinusoidal form, or lose all their original complexity. Similarly, sound waves in air which may be very complex near their source, become smoother at increasing distances and approximate simple sinusoidal fundamental tones, especially if transmitted through solids. We impress upon a telephone transmitter, vocal sounds of great complexity, and the outgoing electric waves along the circuit leaving the transmitter have a like degree of complexity; but, on a long circuit, as the waves advance, the overtones die off, and the wave form tends to the simply sinusoidal. We impress upon the sending end of a long submarine cable a rectangular alternating-current wave form from a battery and vibrating reverser. At the distant end, the arriving alternating current is a simple sinusoidal current. Again, we impress a complex alternating e.m.f. upon a circuit containing considerable reactance, and the current in the circuit tends to become a simple sinusoid. Possibly the simplest explanation for the large group of phenomena, of which only a few examples have above been given, is that of all forms of continuous oscillatory disturbance, the simple sinusoidal disturbance is the smoothest, and if as generally happens, the disturbance meets with opposing reactions, the reactions will be a minimum when the disturbance is sinusoidal. If, for instance, we advance along a road with hills of the same height at uniform intervals, the average rate of continuous ascent or descent will be a minimum when the hills are simply sinusoidal in outline. If the hills are simply pyramidal, with a uniform slope on both sides, the gradient will then be uniformly the same up or down, as the average gradient when sinusoidal, but there will be a sudden discontinuity of motion on the top of the pyramidal hill, a sudden reversal from ascending to descending; whereas there is no such discontinuity, or sudden reversal, on the top of the sinusoidal hill. The effect of reactions on all kinds of transmitted cylic disturbances is thus to reduce them to the sinusoidal form.

The magnetic flux in the induction motor appears to be a case in point. The high frequency secondary currents produced by any distortion in the flux tend to suppress the kinkiness in the wave form of the rotating magnetic field and hence to shear away upper harmonics. Not only for long-distance transmission lines, but also for alternating-current motors generally, the simple sine wave of e.m.f. shows itself the simplest, the most economical and the best. Design of alternators in recent years has tended more and more towards the sinusoidal e.m.f. wave. The only exception to the rule is found in the transformers, which prefer a peaked e.m.f. wave, because the magnetic density they are then called upon to develop in their cores is somewhat less than when the e.m.f. is of the same magnitude by voltmeter but is of sinusoidal form. In most cases, however, the preference of transformers in this matter is overweighted by the preference of lines and motors for smooth sine waves.

The United States Bureau of Standards.

The Bureau of Standards has recently issued its annual report. The importance of this institution as a national asset can scarcely be overestimated. It is the repository of the National Lares and Penates, so far as relates to weights, measures, mechanical, physical and chemical units. It is not too much to say that all of the surveys, measures and measuring instruments of the country depend, either directly or indirectly, upon the standards kept at the Bureau, and upon the faithful comparison at the Bureau between those standards and secondary standards or commercial copies in general distribution. Taking, for example, electrical engineering applications, the many thousands of electric meters on customers' premises in the various cities of the country are standardized and calibrated by comparison with secondary standard instruments in the makers' factories. These secondary standards have always been brought into comparison with the standards kept at the Bureau, either directly, or by indirect succession. Not only are disputes avoided and litigation minimized by reference to the arbitration of the Bureau in the matter of weights and measures, but there is a very great national economy in having the final standards and their comparison entrusted to a single national Bureau, instead of leaving the labor of primary calibration to each individual manufacturer, or each individual seller.

If the Bureau had not been created, it would be necessary either for each individual manufacturer or group of manufacturers to maintain a separate series of primary standards of measure; or to depend upon foreign National Laboratories for this work. Although it is manifestly desirable that all fundamental measures should be conformed to those issued at a single international Bureau, such as the International Bureau of Weights and Measures at Sèvres in France, yet there is a marked advantage and economy in retaining a National Bureau in each country, the duty of which is to keep in conformity with the international Bureau on the one hand, and also to serve the commercial interests of that particular country on the other. Otherwise, delicate instruments would be constantly passing to and fro across the ocean, with much unnecessary delay between manufacturer and standardizer. Not only in its immediate service is the Bureau a national asset and support of industrial precision, but it has also great value from an educational standpoint. Just as a completely untutored savage cannot be accurate in any act or statement, save by chance, so accuracy and precision is the most characteristic quality of the most advanced type of man, be his industry or occupation what it may. That a country maintains a Bureau whose duty is accuracy in industrial service, necessarily means a strong educational and civilizing influence on the community.

The Radioactivity of Uranium Compounds.

The hypothesis most generally entertained at present concerning the origin of the enormous power of the emanations of radium is that the power is ultimately derived from the breaking up and death of uranium atoms. Uranium is the most massive element known to chemists, its atom having nearly 240 times the mass of a hydrogen atom. It is supposed that the dynamic equilibrium of these massive atoms is unstable and that occasionally an atom disrupts or explodes. The event is of extremely rare occurrence, as regards any small group of atoms; but since any appreciable mass of the substance, say a gramme of it, has such an enormous number of atoms, the event of an explo-

sion is of common occurrence. This may be likened to the condition of railroad accidents in the world at large. The event of a fatal railroad accident is extremely rare, and the probability of its occurrence among a given small group of passengers is very small. Nevertheless, taking the aggregate vast numbers of railroad passengers in the course of a year, the total annual number of fatal railroad accidents is relatively large.

It was observed by experimentalists that a substance which contains radium also contains uranium, and a certain degree of proportionality appeared to exist between them. According to the present provisional hypothesis, uranium will, in the course of millions of years, all be lost by decay into radium, or into substances that in their turn give rise to radium. Radium itself has but a limited lifetime, and breaks up into other substances, of which helium is said to be one. The original stock of energy contained in a massive atom of uranium is thus gradually dissipated in the series of explosions or disruptions ending in relatively inert substances like helium. According to this hypothesis uranium, and possibly also other substances of massive atoms, are very slowly undergoing disaggregation or disruption with attendant loss of energy; whereas, according to the Laplacian view of the universe, the process of consolidation or aggregation of mass is everywhere in progress, attended by loss of radiant energy. The *Philosophical Magazine* for January, 1906, contains a paper by Prof. H. N. McCoy on the relation between the radioactivity and composition of uranium compounds, as determined experimentally from five samples of uranium compounds found in different parts of the world. The result of these measurements is that the radioactivity of these ores is, within 1 per cent, proportional to the quantity of uranium they contain. In pure uranium compounds the specific radioactivity is about four times less than in these ores. The results, however, go to support the provisional theory that uranium is the parent or ancestor of radium.

STUDIES IN STEAM ECONOMY.

The valuable paper of Messrs. Stevens and Hobart, which we print this week, may be considered as supplementary to their previous consideration of engine economies. In the present research they take up the operation of the steam turbine under various conditions, and its comparative qualities as related to the reciprocating engine. The results are somewhat at variance with the preconceived notions generally current upon the subject, but they have a direct practical value as being based on actual working conditions. The data for such a comparison at the present time are necessarily somewhat fragmentary and require careful consideration to make them useful. The authors have given them, however, a remarkable analysis, bringing out from them some generalizations that are most instructive. One of the points very clearly brought out is the fallacy in the often repeated statement that the reciprocating engine suffers severely in economy at light loads. A careful inspection of Figs. 31 and 32 in the present paper should go far toward demonstrating the facts in the case. We are sorry that the authors have confined themselves to the Parsons turbines in these comparisons, since other turbines designed along rather different lines would show slightly different characteristics, although perhaps not different enough to change the general conclusions. These figures show clearly what we have often stated, that assuming engines to be designed with reference to light-load efficiency, their economy suffers very little or not at all, within the range of loads which they would in practice carry. The trouble is that most engine builders have not yet bestirred themselves to produce machines of the highest economy, but have adhered to the standard lines popular before the introduction of turbines.

Another most important matter here brought out is the relatively excellent performance of turbines at moderate steam pressures and low superheat. High steam pressure and superheat are of course always valuable, since they increase the available working range of temperature. Turbines, however, appear from the data here assembled to have a better thermal efficiency under somewhat adverse conditions than do the reciprocating engines, provided that these conditions do not include a poor vacuum. On the other hand, an engine designed for high economy seems to gain only in a moderate degree from extremely high vacua, the proportioning of the low pressure cylinder to utilize them entailing somewhat serious general losses. On the other hand, increased working temperature is especially advantageous to the reciprocating engine, which can in this way be pushed to efficiency as yet untouched by turbines. No superheat over 180° F. is considered in the present discussion, so that no extreme figures for economy appear. In spite of this, a figure of about 15 lb. of steam per kw-hour is reached at a little over 200 lb. pressure and 180° superheat in engines of several thousand kilowatts capacity. Recent turbine guarantees indicate that under favorable conditions this economy can perhaps be closely approximated. If one can judge anything from guarantees, always rather uncertain guides, the turbine seems to be a close second under all ordinary circumstances. The data available in this country for checking Stevens and Hobart's values are very meagre indeed, so that their actual figures must be taken with some caution so far as absolute values are concerned. We know of no American tests in actual commercial work anywhere near 15 lb. of steam per kw-hour for either piston engines or turbines. There are almost no turbine tests available, made in regular commercial work save a few with apologies tied to their tails; and the rare tests made on very large piston engines in regular service have shown nearer 17 lb. than 15.

In tests intended as guides to commercial practice, rigorous account should be taken of all the steam used for the auxiliaries, and of the energy required for superheating. This latter quantity is extremely difficult to ascertain save in the case of an independent fixed superheater. In point of fact, when all the auxiliaries, steam and electric, are taken into account, we very much doubt whether in any kind of direct-connected unit 20 lb. of steam per kw-hour at the switchboard is bettered save under very unusual circumstances. That it can be materially bettered admits of no doubt, and we have great hopes that the competition between turbines and piston engines will prove an active agent in improvement. If Stevens and Hobart's data are trustworthy it appears, as we have been disposed to think, that the steam turbine is particularly in its most advantageous field in units of moderate size, with first-class vacuum and moderate conditions of pressure and superheat. When the direct-current turbo-generator takes its proper place in the art it should be able to give, for instance, highly valuable results in plants of moderate size. Some of the best published results from turbines have been in the smaller sizes. It would consequently seem that it would be worth while to push these machines most actively in this field where these good qualities count for most, although such use is less striking than their adoption in the great power stations in which they have been chiefly exploited up to the present.

The Institute Nominations.

Much interest is shown in the nominations for the vice-presidencies and managerships in the American Institute of Electrical Engineers. Several excellent names have already been proposed from different parts of the country and the several branches of the profession, and while the list is doubtless incomplete, the following may be noted: For vice-president, Dr. Louis Bell, F. G. Baum, H. L. Doherty, W. C. L. Eglin, A. M. Hunt, H. H. Humphrey, Dr. F. A. C. Perrine, P. N. Nunn, J. G. White. For manager: C. B. Burleigh, J. J. Carty, G. A. Damon, P. M. Lincoln, C. O. Poole, F. W. Roller, Paul Spencer, P. Torchio, P. H. Thomas. Some of these gentlemen have already served the Institute; others represent the younger public-spirited element from which the strength of such a body must always be recruited.

In connection with the campaign, no little excitement and indignation appears to have been aroused in Philadelphia by the anonymous circulation of a full ballot, headed by the name of Dr. Sheldon, and issued by a "Local Organization Campaign Committee." The officers of the local chapter have no knowledge of the matter, as a body, and the extraordinary thing is that the circular mailed with the ticket has a "fake" address, there being no such street number in the city, it is said, as that given on the circular. It is stated from Philadelphia that some formal action is to be taken by the local membership condemning this curious proceeding. One of the alleged candidates on this ballot has telegraphed us as follows: "Use of my name unauthorized by me; I know nothing of the source from which the circular emanated."

A circular to the membership at large has been issued, advocating the candidacy of Mr. E. W. Rice, Jr., for president, signed by Messrs. T. A. Edison, Elihu Thomson and F. P. Fish. A further circular endorsing the same candidacy has been issued by Mr. John J. Carty, who refuses to allow the use of his name as a candidate for the office The nomination blanks have to be returned before March 1.

International Electrical Congress of St. Louis.

The affairs of the International Electrical Congress of St. Louis, 1904, have been finally closed and a statement of the Treasurer, audited by the Audit Company of New York, is being forwarded to members of the Congress, which statement shows a balance on hand of $2,046.37. The Executive Committee has directed that this sum shall be offered to the Library of the American Institute of Electrical Engineers as a fund in perpetuity, the annual proceeds to be devoted to the purchase of international electrical literature. This condition was made in view of the large foreign membership in the Congress—almost 25 per cent.

The statement says that a deficit was warded off by the sale of *Transactions* at $10 per set, the membership fees received not being sufficient to meet all the expenses of the Congress, including printing and distributing the *Transactions*. When the probability of a deficit became evident a systematic canvass was instituted for the sale of *Transactions*, which produced $2,678.82. Part of the balance on hand—about $500—is due to a binding arrangement whereby the Congress was saved the cost of delivery of the *Transactions* of those members who desired to have their copies bound. The arrangement gave members the advantage of edition cost of binding which, with the cost of delivery added, was somewhat less than the usual cost of job binding.

The total membership in the Congress was 2,068. The cost of the stenographic report at St. Louis was $1,000.35; $518.66 was expended for postage, and $721.50 for distributing *Transactions* to members. The total cost of delivery to members in the United States was about 70 cents per set; to members in Europe 55 cents, and to members in Japan, 35 cents. The three volumes of *Transactions* contain 159 papers, 2,844 pages, 698 illustrations in the text, 124 half-tones on inserted coated sheets and three photogravure frontispieces. The copies printed for sale were exhausted several months ago, and the demand which continues for the *Transactions* may justify the Library of the American Institute of Electrical Engineers, as the legatee of the Congress, to arrange for the printing of a small edition from the plates.

Chicago Drainage Canal Power Offered for Sale.

The Sanitary District of Chicago, which is developing a large water power plant on the Chicago Drainage Canal at Lockport, Ill., according to an announcement recently issued by Robert R. McCormick, president of the drainage board, expects to be prepared to deliver power from its new plant by January 1, 1907, and the trustees are prepared to enter into contracts with Chicago or any of the other municipalities within the limits of the sanitary district for such electrical energy as may be required for municipal purposes. The estimates upon the cost of generating and delivering this power have been made by the engineers of the sanitary district, of which Mr. Isham Randolph is chief engineer and Edward B. Ellicott assistant engineer, in charge of electrical work. The power is offered to the city of Chicago for municipal purposes at a price of $26.40 per horse-power per year on a basis of 24-hour service per day. Anticipating that a municipality may not be able to use power 24 hours a day, another alternative price of $20 per horse-power per year has been made on a basis of 12 hours' service per day, the trustees of the sanitary district endeavoring to dispose of the power for the remaining 12 hours. President McCormick states that the price of $26.40 per horse-power per year for 24-hour service represents the true cost to the sanitary district and gives the following itemized estimate:

Total cost of development and transmission		$3,500,000.00
Estimate of Cost.		
Interest on investment at 4%	$140,000.00	
Taxes on real estate, building, etc	7,620.00	
Depreciation on buildings, at 1%	3,650.00	
Depreciation on water wheels, at 2%	2,027.32	
Depreciation on generators, at 2%	1,824.60	
Depreciation on pole line, at 3%	2,020.50	
Depreciation on other electrical apparatus at 3%	3,995.52	
Total fixed charges		161,137.94
Operating Expenses.		
For power and sub-station labor	$63,240.00	
For repairs to machinery and buildings	3,700.00	
For incidental expenses	1,200.00	
Operating Lawrence Avenue Pumping Station	43,960.00	
Operating 39th Street Pumping Station	120,380.00	
Interest on investment, 39th St. Station, at 4%	15,599.76	
Total operating expenses		248,079.76
Total cost per year to Sanitary District		$409,217.70

With 15,500 horse-power delivered at the sub-station the cost per hp-year will, therefore, be $26.40. To avoid delays in considering the application of electrical power the following data is given: Power will be delivered to purchasers at the sub-station located at West 48th Avenue and the Canal. The responsibility and cost of transmission from that point must be assumed by purchasers. Power will be measured at the sub-station switchboard, assuming 746 watts as a horse-power. Alternating-current of 60 cycles at either 6,600, 9,000 or 11,000 volts will be furnished.

When the full flow of water is available in the Canal, which will probably be within six or seven years, the power can be increased to 31,000 horse-power with an additional outlay of $450,000. The true cost will then be reduced to $14.97, and it is the intention of making a provisional reduction to this figure in all contracts made at this time, to the effect that all municipalities entitled thereto may secure the benefit of the power at cost to the Sanitary District.

No action has been taken by any of the officials of the city of Chicago toward accepting this offer, although the general sentiment seems to be favorable to it. Mr. William Carroll, city electrician, has asked for an appropriation of $500,000 to make the necessary changes to put the city in a position to utilize this power. No definite plans, however, have been worked out.

A large part of the municipal street lighting system of Chicago consists of direct-current open arcs. Some of the newer circuits are alternating current. If the city uses the drainage canal power, it will be necessary either to change the direct-current series arc system to alternating-current enclosed arcs or to install alternating-current motors at the present power plants to drive the present direct-current arc machines. The latter change, although the cheapest one to make, is not favored by Mr. Carroll because of its inefficiency, and the fact that it would continue in operation a lot of obsolete apparatus which might better be changed at the start. Mr. Carroll estimates that the street lighting of Chicago will be sufficient to take the entire output of the Lockport plant even after the full flow of water is available in the canal and the output increased to 31,000-hp.

Inasmuch as Chicago newspapers have laid considerable emphasis on the exceeding cheapness of this power as compared to that supplied by the Chicago Edison Company to private consumers, it is interesting to note that $20 per horse-power per year, 12 hours each day, amounts to 6 cents per kw-hour. As the load factor in commercial lighting and power, that is, the ratio of the average to the maximum power required in a day, is seldom better than 50 per cent and frequently falls as low as 10 or 20 per cent of the maximum, it is evident that this cost of 6 cents per kw-hour would be from 1.2 to 6 cents if it were applied to commercial work. To this must be added the cost of operation, interest and depreciation on sub-stations and distributing systems so that by the time the drainage canal power would get to the consumer if used for ordinary commercial purposes, it would cost fully as much as the prevailing central station rates in Chicago. There are plenty of motors connected to central station service in Chicago that do not pay more than $20 to $25 per year per rated horse-power.

A Successful Apprentice School in an Electrical Factory.

A recent issue of the *National Civic Federation Review* gives a full account of an address delivered by Mr. M. W. Alexander before the National Civic Federation dealing with the theoretical and practical training of boys in the West Lynn shops of the General Electric Company. We present below a brief abstract of the address.

The apprenticeship system was organized in February, 1902, for boys of at least 16 years of age, who had obtained a grammar school training and were desirous of learning a trade. The period of apprenticeship lasts four years, during which time the boys are taught the trades which are practiced in the factory. The aim is not only to make of these boys efficient machinists and tool makers, pattern makers and carpenters, iron, steel and brass moulders, instrument makers and electrical workers, but to develop a class of artisans from whom can be chosen men for the leading positions in the factory, for assistant foremen, foremen and master mechanics. It was found desirable to incorporate with the apprenticeship system a school especially fitted for the needs of the apprentices.

Each boy receives three years of instruction. He enters school after he has been an apprentice for about six months and he graduates from the school several months before he graduates from his apprenticeship. Each school year consists of forty weeks with two sessions of two and one-half hours each per week. A large part of the teaching is merely a review of some of the grammar school work, but applied to practical factory conditions. Experience has shown that it is desirable to devote a good share of the time to this review and to carry it back to the elementary stage of the subjects.

The rest of the time is devoted to subjects which either have not been taught in the grammar school at all or have been touched upon only in a general way.

In commenting upon the training obtained in grammar schools, Mr. Alexander said: "The question will arise: Why should we, who have had no pedagogical training, attempt to review what has already been taught in the public schools by pedagogically trained teachers? With all due respect to our public schools, excellent as they are in the main—and nobody has a higher regard than I for a teacher and his efforts—I find from my years of experience that the public schools fail to teach the boy to think for himself and to think clearly and logically. The school has taught the boy a great amount of knowledge and has committed to his memory many formulas, but when it comes to the application of this knowledge and of these formulas to practical uses, many a boy finds himself blocked, because he has not acquired the faculty of independent thinking. Our review, then, aims to instill in the boy the habit of independent thinking."

During the first year English and mathematics are taught, one-third of the time being devoted to the former and two-thirds to the latter. In English, the spelling of technical terms is first taken up and then followed by short dictations explaining technical processes, describing materials and their properties and various kinds of apparatus. The boy, therefore, becomes acquainted in a general way with all the practical work. In the instruction in mathematics only concrete examples are given by the teachers, who aim to lead the boy on to independent thinking and to make him acquainted with the very technical arithmetic which he may have to use as a shop foreman. It is only a test of the boy's memory when he is asked to solve '$3 \times 420 \times 12$,' but it is an entirely different test if the same problem is put in the following manner: 'A factory consists of three rooms; each room is lighted with twelve arc lamps, each of which requires 420 watts of power. How much horse-power will have to be provided for the lighting of the whole factory if 746 watts equal one horse-power?' In stating such a problem an explanation is given in the very briefest manner of the meaning of 'watt' as a unit of power, and also the nature of an arc lamp, showing the outside appearance of the same and the inside mechanism.

An examination is held at the end of each term, and only those apprentices who obtain a percentage of 60 or more are allowed to advance to the next school term. Some have been left behind. The knowledge of their failure, however, became quickly known among their shopmates and had a most stimulating effect on the mental machinery of these boys. The final examination after three years of schooling is a competitive one, wherein everyone who obtains a percentage of 95 or more is presented by the company with a technical book or a useful working tool. The standing obtained in the school is also stated in the "certificate of apprenticeship," which is given to the boy at the successful termination of his apprenticeship, together with a cash bonus of $100.

In an apprentice training room, the equipment has cost about $5,000, and an additional $3,000 will be spent within the next half year for the purchase of new machines. These machines are a good investment and can be used anywhere in the factory. "The General Electric Company," Mr. Alexander said, "does not believe in letting anything go to waste. No money is spent in a purely sentimental way; there is always a straight business proposition at the bottom of things. If that were not the case I would not care to help in the work."

Printing Telegraph.

Three patents were issued on February 6 to Mr. John C. Barclay, assistant general manager and electrical engineer of the Western Union Telegraph Company, on separate features of his printing telegraph system, which has already been referred to in these columns. One covers a keyboard telegraph transmitter; another relates to the printing mechanism of the receiving apparatus and the third has for its subject a relay used in connection with the transmitting apparatus. The keyboard transmitter is intended primarily for use in connection with Mr. Barclay's page-printing telegraph printer, although it is not limited to this particular application.

The essential parts in combination consist of several adjustable stops or circuit-controlling devices, adjustably mounted on a movable drum, and arranged to be adjusted in position ac-

cording to the character to be transmitted. The stops are arranged and set into position by the manipulation of the keys on the keyboard, which is practically similar to that of the ordinary typewriter. The stops so set represent the dots, dashes and spaces comprising the characters of the alphabet or code, the next stop in the sequence of operations being the actual transmission of the characters to the line. One of the problems in developing instruments of this class has been to devise means to secure uniform spacing between characters. The letter "E," for instance, in the Morse code is represented by one dot, while the character for a paragraph is four dashes, and that for the numeral 6 is six dots. If unit time were allotted per character it is obvious that the spacing between characters would vary inversely as their length. It is necessary in instruments of this kind to keep the space between characters uniform.

Mr. Barclay accomplishes this result in a very ingenious manner, and this is one of the objects of the present invention, others being, certain and rapid operation, ease of operation, ease of inspection and keeping in order, and relative economy. The stops may be set either by electro-mechanical means or by mechanical means. The drawings show the apparatus operated by electromagnets, these being controlled by the depression of the key levers by hand. For the protection of the instrument the transmitter is not connected directly to the line, but operates a relay which repeats the signals into the main circuit. The second patent covers an improvement in the printing mechanism of the page-printing receiving apparatus used by Mr. Barclay in the printing system. The type characters are arranged on the surface of a wheel, like a ticker type wheel, which is revolved until the desired character is brought into printing position; the wheel is then moved forward into contact with the paper, thus printing the characters in sequence.

It was found that when such printing mechanism was operated at high speed some characters missed position. The object of Mr. Barclay's invention is to prevent this missing of characters and secure certainty and reliability of action. The relay described in the third patent is designed to control a large number of electrical circuits and is particularly intended for use in Mr. Barclay's printing telegraph system. It may be either of the polar or the neutral type. The instrument represented in the drawing has an extension of the armature lever, at the outer end of which is a recess which engages a pin on a rocker or drum placed vertically upon the base of the instrument. The body of the drum is of insulating material, but through it, longitudinally, are arranged contact pins which close the various circuits by coming into contact with contact fingers on one side or the other as the armature lever vibrates. The contact fingers, representing circuit terminals, are arranged in two vertical rows parallel to the axis of the drum, so that when the armature lever is on one side one row of contact fingers is connected in circuit and with the armature on the other side the other row is in service. The pins project through the rocker from back to front. The back contacts constitute the other terminals of the circuits. In a general way the drum and its functions are similar to those of the electric railway car controller on a small scale.

Induction Motors for Traction.

A patent issued February 6 to Mr. A. H. Armstrong discloses means for maintaining an equal distribution of load between several polyphase induction motors used for railway work.

An efficient induction motor is substantially a synchronous machine; that is, it operates normally with a small slip. Consequently if the driving wheels of a vehicle are of unequal size, due to unequal wear, or if two cars or locomotives with wheels of different size are coupled together in a train, the synchronous characteristic of the motors produces an unequal distribution of load. Thus, for instance, if the motors operate at full load with a five per cent slip and if one driving wheel is five per cent smaller than another the motor geared to the larger wheel may be operating at full load with five per cent slip, while the motor geared to the smaller wheel may be running at synchronism, and consequently doing no work whatever. If the inequality between the wheels is greater than the slip, the motor geared to the smaller

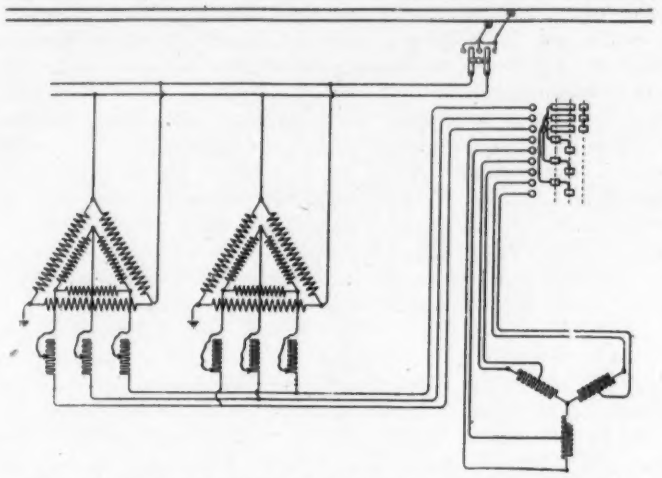
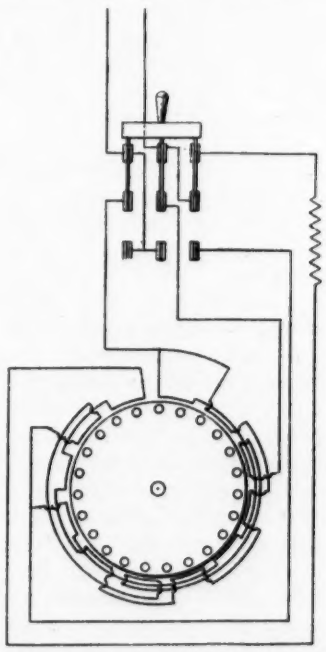


DIAGRAM OF CONNECTIONS OF POLYPHASE RAILWAY MOTORS.

wheel may even be operating as a generator, returning power to the line, and thereby acting as a brake to overload further the other motors. The inventor connects independent adjustable resistances in series with the secondary windings of the several motors, respectively, as indicated in the accompanying illustration.

Single-Phase Induction Motor.

As is well known, at or near half-speed a single-phase induction motor has considerable torque. The accompanying illustration shows a scheme proposed by Mr. B. G. Lamme in a patent issued February 27, for bringing the rotor up to half speed in order that the machine may then be switched to the simple single-phase connection. The main primary winding is divided into two groups of coils, which are connected in series



SINGLE-PHASE INDUCTION MOTORS.

in starting the motor and in parallel for running, the current being reversed in one portion of the winding. The number of the poles induced in the primary member with the two portions of the windings in series is double the number corresponding to parallel connection of the two portions of the windings. The number of the poles produced by the current in the auxiliary winding is equal to the number of poles due to the current in the main winding when its two portions are connected in series. The usual "phase-splitting" resistance is connected in the auxiliary starting circuit.

CURRENT NEWS AND NOTES.

HONORS FROM GÖTTINGEN.—Prof. J. J. Thomson, of Cambridge; Mr. Oliver Heaviside, of London; M. Henri Becquerel, of Paris, and Prof. P. Zeeman, of Amsterdam, were made honorary doctors of the University of Göttingen, on the occasion of the dedication of the new physical laboratory.

LECTURE ON TELAUTOGRAPH.—Mr. James Dixon, electrical engineer of the Gray National Telautograph Company, will lecture on the improved telautograph before the Electrical Engineering Society of Columbia University, in room 301 of the Engineering Building, at 8.15 p.m., on March 7. An invitation to attend is extended by the society to those who are interested in the subject.

ELECTRICITY VS. GAS.—Gasoline or vapor lamps now in use in Memphis, Tenn., will give way to electric arc lamps in a short time. The lights have not given satisfaction and electricity will be substituted in all cases where it is possible. The city now uses 440 electric arc lamps, paying $85 a year for each lamp. It is stated that in case a number of additional lamps are used a rate of $75 a year can be secured. The city has 825 gas lamps at $25.60 a year and 430 gasoline lamps at $24.60 a year.

RADIO-TELEGRAPH RATES.—Mr. David J. Hill, U. S. minister at The Hague, reports that the Netherlands Government has issued an order respecting the exchange of radiotelegraphic messages, and fixing a provisional tariff in regard thereto. The rate will be 10 Dutch cents per word, with a minimum of 1 florin, which is equal to 40 cents per message, and in addition a ship's tax may be allowed of ten Dutch cents per word.

FOR PURE SCIENCE.—The cause of pure science has been benefited by the recent action of Mrs. Elizabeth Milbank Anderson, of New York City, who has added to a sum approximating $2,900,000 already donated by her to the institution, another gift of $100,000 to Barnard College. Her latest donation is to be used for the establishment of a pure science course to lead to the degree of bachelor of science. Two members of the Board of Trustees, whose names are withheld, have offered to guarantee any deficit arising by reason of expenditures for the new course during the next ten years to the amount of $20,000.

WIRELESS IN MEXICO.—U. S. Consul Kaiser, of Mazatlan, writes: "Wireless telegraphy was put in public service on January 1, 1906, and messages are now being sent and received for Guayamas and Santa Rosalia, Lower California, the latter place having been, up to said date, without telegraphic communication. The tariff rate for a message is $1 American currency for each ten words, and 10 cents American for each additional word. It is too early to give an opinion as to the success of the system, which consists of two plants, called the "Slaby Arco" and Telefunken," both of which have been imported from Germany.

COST OF POWER IN BUFFALO.—Mayor Adam transmitted to the Board of Aldermen recently two communications which he had received from prominent manufacturers relating to the cost of power in Buffalo. It was stated in one letter that a large Chicago establishment which desired to locate in the city had found upon inquiry that it could get an electric hp-year for from $6 to $8 less outside the city than in Buffalo, and that one small city outside of Buffalo will in a short time be in position to supply energy at $9 less than the minimum price in Buffalo. C. H. Kellogg wrote that his firm after a trial of electricity, substituted gas engines, electric energy having cost it $68 yer horse-power per year.

WIRELESS STATION STARTS.—The American De Forest wireless telegraph station in Springfield, Mass., was formally opened on February 13 and is now ready for commercial work. A number of congratulatory messages were forwarded at 1 o'clock, the first one being from Mayor Dickinson to Governor Guild, as follows: "On the whispering winds I send you hearty congratulations upon the auspicious outlook for your administration." The mast from which the messages are sent is 210 ft. high. Current for operating the station is secured from the United Electric Light Company. The company has secured downtown offices in the Whitney Building, from which messages will be communicated by telephone to the sending station on the Hill.

WIRELESS DEPOTS ON CANADIAN COAST.—Commander Spain, of Ottawa, Ont., has submitted a report on the operation of the Government wireless stations on the coasts of the eastern provinces. There are thirteen stations in all, ten of high power and three of low power. The initial cost of each high-power station is $8,500, and of each low-power station $5,000. The annual cost of maintenance is about $1,800 in each case. Several Government vessels are also equipped with Marconi apparatus, the cost being $1,550 for each ship. The adoption of this system enables constant communication to be maintained all round the eastern coasts from Anticosti to Belle Isle, then to Cape May, Cape Race, Sable Island, Halifax, around the western coast of Nova Scotia and up the Bay of Fundy to St. John. On the occasion of the recent visit to Canada of the battleship Dominion, the Government stations were enabled to communicate with her at a distance from Halifax of 950 miles.

OWNERSHIP AGITATION EFFECTS.—Anxious interest has been aroused by the decline in the value of New York City bonds, since the municipal ownership campaign began. Accountants in the Finance Department have been making a careful examination of the records of municipal bond sales in the last ten years for the purpose of analyzing the results of last week's sale, when the city secured an average price of only $108.052 for $20,000,000 worth of 4 per cent bonds. These were the first 4 per cent bonds that the city has issued in a quarter of a century. The investigation has shown that in the years 1898, 1899, 1900, and 1901 the city repeatedly and almost continually sold 3½ per cent bonds at prices materially higher than was received last week for 4 per cents. The investigation also showed that on averages the city is paying to investors a higher rate for money than it ever has been obliged to pay since consolidation, and that the rate is likely to increase, for, although the city is prohibited by law from paying more than 4 per cent on its bonds, the price at which these bonds will sell is prospectively dropping. The investigators say that this is due in part at least to the municipal ownership agitation and to the likelihood of many large issues being thrown on the market, and therefore the city will be receiving less and less premium on its issues.

ELEPHANT POWER.—A correspondent in the East Indies addresses the following inquiry to London *Engineering*: "We have a number of elephants in the State. I propose to utilize them in working dynamos for six hours every day and generating electricity to store it in batteries and use it at night for lighting streets. I shall feel obliged if you will please give me the information required in the statement accompanying: 1. How many electrical units will an elephant of ordinary strength, working six hours, produce? 2. Cost of dynamos required. 3. Cost of gear required to work it by elephants. 4. Cost of battery to store the electricity." The journal remarks: The mechanical equivalent of the power of an elephant is probably known in India, but we have not been able to find it in textbooks published here. Probably, as compared with that of a horse, it varies as their respective weights. A central station containing a score of elephants walking round like mill horses, or climbing ramps that slipped away under their feet, would be rather a painful spectacle. Apart from this, however, we see no way in which the enterprising department in question could utilize the source of power at their disposal. We do not suppose elephants could be trained to raise water in their trunks and spurt it on a Pelton wheel; and as we have no means of calculating the force of a jet of this kind, we are not able to recommend this means.

THEFT OF COPPER WIRE.—The extent to which the stealing of copper telegraph and telephone wire has developed in this country is indicated by the fact that more than 40 wire thieves are now serving terms in the penitentiary.

PROPOSED MILWAUKEE LIGHTING COMMISSION.—Alderman F. J. Stiglbauer, of Milwaukee, Wis., is in favor of the creation of a lighting commission patterned after the one in Detroit, Mich., and is preparing to introduce a resolution providing for the appointment by the Mayor of five commissioners to be confirmed by the Council, who are to be given power to construct and operate the proposed city plant.

ILLUMINATING ENGINEERING SOCIETY.—In our report of the recent meeting of the Illuminating Engineering Society, through a typographical error the membership was stated to be 50, instead of 150. Since the meeting the enrollment has reached 180, with a number of applications yet to be acted upon. Many of the recent comers are from the South and West, with one from Havana and another from Winnipeg, Canada.

STOCK FOR EMPLOYEES.—The Michigan State Telephone Company has established co-operative relations between itself and its employees by issuing stock to the latter upon advantageous terms. The company obtained an option on a block of preferred stock at 90, which is 7 points under the market price. Circulars were sent out to the employees, offering from one share up, and $60,000 worth of the stock was subscribed for. The stock is held by the company until paid for by the employee, who receives the dividends, and who is credited with interest on the money he pays at the rate of 6 per cent a year.

ELECTRICITY FOR SOUTHERN INDUSTRIES.—A number of large industrial developments are under way in North Carolina, which it is expected will greatly increase the demand for electric energy for motors. Among the consumers is a new cotton mill to be erected at Dallas, Gaston County, which will have 5,000 spindles for the manufacture of yarns. The mill was operated by electricity to be secured from either W. T. Love, of Spencer Mountain, or the Catawba Power Company. The Brown Manufacturing Company is also installing a textile mill, operating 7,860 spindles and 300 looms, the motive power for which will be electricity. The Southern Power Company has secured a number of contracts for power from mills in and around Gastonia, which will probably be supplied from its new station at Great Falls as soon as it can be completed.

GASOLINE MOTOR CARS.—Southern Pacific R. R. officials have recently tested a gasoline motor car on one of the company's interurban lines out of Los Angeles, and it is stated that another motor car has been ordered. It is reported that Salt Lake City railway officials are considering the use of gasoline motor cars for use on their suburban lines. The Pennsylvania R. R. has been running an experimental gasoline-electric car over its main line and branches in the vicinity of West Chester, Pa. Two trips were recently made over the Pomeroy & Newark Railroad, where the present train service is poor, and a trip was made over the Downington & Lancaster Railroad. The J. G. Brill Company is building several Strang gasoline-electric cars, for the Missouri-Kansas Interurban Railway Company.

BRIDGES FOR POWER WIRES.—An agreement has been reached before the Board of Railway Commissioners, of Ottawa, Ont., between the representatives of the Ontario Power Company, of Niagara Falls, and the Grand Trunk Railway Company with reference to the carrying of the company's high-voltage wires over the railway company's tracks. The power company undertakes to use light steel bridges for supporting the wires, with a span of 56 ft. over single tracks and 76 ft. over double tracks. Where telegraph wires are outside the ends of the bridge, they are to be protected by guard wires with a 24½-ft. clearance from the rail of the bridge. The Grand Trunk Railway Company waives its objections to the turning on of the current immediately, the power company to assume all responsibility for accidents. The steel bridges are to be constructed within 90 days.

LABORATORY WORK IN PENNSYLVANIA STATE COLLEGE.—In the course which is offered in electrical engineering at the Pennsylvania State College much emphasis is placed upon the importance of laboratory work as an invaluable aid in causing the student to appreciate the significance of the theory which is obtained from textbooks. For four hours per week during two and one-half semesters, the work includes electrical measurements, study of instruments, testing of direct-current machinery, and the first part of the course in alternating-current laboratory work. During the remainder of the course, which extends over a total of four semesters, four hours per week are devoted to the testing of alternating-current machinery. The students are required to submit, at stated times, reports of the experiments performed in the laboratory, in the preparation of which they display an exceptional amount of interest. Accompanying the report of each experiment are well-executed diagrams showing the machine or instrument being tested and its position in the testing circuits. In connection with these diagrams is a complete description of the object of the test and the method of performing the experiment. The experimental observations are recorded in neatly arranged tables and plotted in the form of curves, which are then analyzed and discussed by the student. The results obtained show that the labor and care which are devoted to the experiments and the reports form one of the most useful parts of the training in engineering which it is possible for the student to acquire in college. The laboratory course is given under the direction of Prof. H. P. Wood, who is assisted by Dr. R. E. Myers, Mr. A. R. Dennington and Mr. E. E. Godard. The department of electrical engineering is in charge of Prof. J. Price Jackson.

ELECTRIC POWER FOR CANADIAN CITIES.—An interesting address on Ontario's water powers and their possibilities was recently delivered at a meeting of the Borden Club, of Toronto, Ont., by Hon. Adam Beck, of London, a member of the Provincial Cabinet. While refraining from giving any inkling of the possible trend of the reports to be submitted to the Government shortly by the Hydro-Electric Power Commission and the Municipal Power Commission, of both of which bodies he is a member, Mr. Beck's address was, nevertheless, considered as encouraging by those who favor action on part of the Ontario Government toward control of the great natural sources of power as Ontario possesses. Mr. Beck said the Government had not yet formulated its policy in regard to the question, but taking as his authority statistics and facts which have been made public, he did not hesitate to say that electric energy at $17 per hp-year should and would be ultimately available in Toronto, provided the municipal authorities were alive to their privileges and opportunities. Manitoba, he said, had already gone far in developing its water powers, and the City of Winnipeg had recently not only secured control of 100,000 horse-power, but had taken the drastic action of shutting out a private power company. Dealing with the question of rates and the possibilities of municipal transmission and distribution of power, Mr. Beck cited the case of Guelph, which last year had a revenue of $25,000 from its water works, electric light plant and street railway, which might be doubled if the city could purchase power to run these utilities at half the present cost. A Montreal company, Mr. Beck stated, is supplied with energy from Shawinigan Falls, 91 miles distant, for $15, which is resold to consumers for about $75. Hamilton, which has had water power for years, is paying more than Toronto or London for its lighting, although the electricity in those cities is generated by steam. Toronto, he said, will reap no advantage from Niagara energy at $35, since it can be generated as cheaply with coal.

ANOTHER ELECTRIC TUNNEL.—A dispatch from Providence says that the New Haven Railroad has practically decided to expend $2,000,000 in the construction of a tunnel, two miles long, from the Union Passenger Station to East Providence, where it will connect with the Boston, Worcester & Fall River tracks. The motive power will be electrical.

GOVERNMENT OWNERSHIP OF TELEPHONES.—The Legislation Committee of the Toronto, Ont., City Council has recommended that the council petition the Dominion Parliament for permission to take over the telephone business of the province and operate the same. It is said that the City of Toronto has already lost a quarter of a million dollars in the past ten years by not accepting an offer that was made at that time by the Bell Company, and the opinion seems to prevail that the city should either go into government ownership or make a contract with the existing company.

N. E. L. A.—President Blood, of the National Electric Light Association, spent several days in New York last week in consultation with other officers of the association regarding the development of plans for the Atlantic City convention to be held in June. Although the programme of the meeting is not complete as yet, sufficient papers and reports have been promised to assure ample compensation to all who are in attendance. A large number of applications for associate membership have been received in the past week or two owing to the desire of manufacturers to supply companies to secure good locations for their exhibits.

BUYING LAND BY WIRELESS.—Ex-Congressman Jefferson M. Levy, who has just arrived in London, bought property in New York City by wireless from his cabin on the *Kaiser Wilhelm der Grosse* in midocean. Mr. Levy had the Maiden Lane property submitted to him by a broker as he was sailing. He thought well of it, particularly as he already owned the adjoining buildings, but there was not time enough to arrange the terms of the deal before the next morning. Negotiations with Mr. Levy were kept up, however, through the Marconi station at Nantucket, and later through that at Sable Island. The last exchange of messages was effected in midocean through another liner, between the big *Kaiser* and the shore, until all the details of the transaction had been arranged.

GREAT FALLS PLANT NEARLY COMPLETED.—The first of the three plants being installed by the Southern Power Company at Great Falls on the Catawba River in South Carolina is nearing completion, and the 45,000 hp which will be developed at this plant will soon be available for transmission. The initial installation will include six 5,200-hp twin water turbines operating at 225 r.p.m. under a 72-ft. head, to which will be added two 700-hp horizontal turbines for driving the exciter generators. The water from the tail race after leaving the turbines is to be turned back into the river bed. The current will be distributed over a section about 160 miles long by 60 miles wide. One line will run up the river to the Catawba power plant, whence it will be transmitted to Charlotte, Gastonia, Rock Hill and other points. Other main lines will be run to Columbia, Spartanburg and other principal manufacturing points in South Carolina.

DRAINAGE CANAL ELECTRIC POWER.—The Board of Trustees of the Chicago Drainage Canal has fixed the price for electricity to municipalities and park boards within the sanitary district at $26.40 per hp-year, which represents the actual cost of the power according to an itemized statement prepared by the chairman of the committee. The total cost of development and the transmission of power is placed at $409,217.70. The board can deliver 15,500 hp at the sub-station at West Forty-eighth Avenue and the canal, and the purchasers will have to convey the power from the sub-station. The report of the committee further says that when the full flow of water is available in the canal, which probably will be in six or seven years, the power can be increased to 31,000 hp with an additional outlay of $450,000. This would reduce the cost to $14.97. The drainage board will make provision for such reduction in all its contracts.

HONORING FULTON'S MEMORY.—The Robert Fulton Memorial Association, which was organized recently to erect a suitable monument to the inventor of the steamboat, and possibly a tomb for him, in the centennial year of the first sailing of the *Claremont,* the pioneer steamer, has been incorporated at Albany. The incorporators are Samuel L. Clemens (Mark Twain), R. Fulton Cutting, Andrew F. Burleigh, Gen. Frederick D. Grant, Col. H. O. S. Heistand, United States Army; Hugh Gordon Miller and others. Gen. Grant has consented to serve as temporary president of the association, but as he feels that his military duties would prevent him from devoting as much of his time to the work as he would wish he has asked that some one else be selected permanent president. The incorporators are now considering three men of national reputation for the office. It is intended to have the monument erected on some suitable spot overlooking the Hudson. Among those appointed to serve on the general and executive committees of the association are John Jacob Astor, William Bayard Cutting, Austen G. Fox, W. H. Fletcher, Bishop Coadjutor David H. Greer, Gov. Higgins, Admiral George W. Melville, John E. Parsons, E. E. Olcott, George L. Rives, James Stillman, Horace White and George Foster Peabody.

MUNICIPAL LIGHTING IN VERMONT.—The village of Northfield, Vt., buys from private company the electricity required for lighting the streets and private houses. The current from the plant on Mad River is delivered at the transformer house in the village and there the responsibility of the electric company ends. The village owns the poles and the street lamps, it wires the stores and residences, makes all repairs, fixes the price and collects the bills. The town originally owned its plant, which was built twelve years ago, and which with the three water powers purchased imposed a bonded debt of $30,000 on the village. In October, 1904, the municipal plant was burned, and Messrs. Moody & Almon, the owners of the Mad River plant, were then asked to supply energy temporarily for lighting purposes. After a trial of a few weeks a contract was made for a year. The question of rebuilding the old plant remained under consideration, but at a special meeting recently called to act on the matter it was voted to renew the contract with Moody & Almon for ten years at $4,500 a year, the company to receive in addition a percentage on all new business added. The village leases its water power to the Rabidou Lumber Company. A steam plant has been erected for use in case of emergency, but has only been needed once for a few hours.

METRIC IN NEW JERSEY.—In the New Jersey Legislature on February 14, the body without a dissenting vote placed itself on record as favoring the passage by Congress of the Littauer bill providing that the metric system shall be employed in the transaction of the business of the United States government. The action of the Legislature consisted of the adoption of the following Senate concurrent resolution introduced by Mr. Hutchinson, of Mercer County: Whereas it is represented that the business transacted through the Custom House of the United States is greatly hampered and made expensive by reason of the necessity of the reduction to the basis of the federal system of invoices made under the metric systems of other countries; and Whereas it is deemed advisable that a common and scientific system should be used for such transaction the world over; and Whereas the Littauer bill now pending before the Committee on Coinage, Weights and Measures of the House of Representatives provides for a moderate and conservative advance towards the adoption of the metric system in this country by providing that it shall be employed in the transaction of the government business; therefore, be it hereby Resolved, the House of Assembly concurring, That it is the sense of the New Jersey Legislature that the Littauer bill should be passed by Congress, and that the Senators and Representatives from this State be and are hereby respectfully requested to support that measure; and, further, be it Resolved, That a copy of this concurrent resolution be sent to each of the United States Senators and Representatives in Congress from New Jersey.

CABLE TO PANAMA.—A bill has been introduced providing for an appropriation of $1,000,000 for the construction of a cable from Key West, Fla., to Guantanamo, Cuba, and thence to the canal zone on the Isthmus of Panama.

MEXICAN POWER PROJECTS.—Writing from Durango, United States Consul Le Roy says: "It is reported that a large company has been formed to exploit the extensive water power near Guanecevi, using it to supply with power the camps at the latter place and at Parral, as well as to operate an electric railroad between these two camps. The details of this organization are not known at this point, except that it is an American enterprise."

SALE OF FRANCHISES.—The Newark, N. J., Board of Trade has received a report from the legislative committee of the organization, which recommended the adoption of a resolution calling upon the Legislature to pass a law limiting all public utilities franchises to twenty-five years. The resolution also provides that such a law should be brief and set forth specifically that at the expiration of the franchise period the property ownership shall revert to the municipality, and that it shall then be sold at auction to the highest bidder. The resolution was adopted by an almost unanimous vote.

PRIVATE TROLLEY LINE.—It is stated from Paterson, N. J., that Mr. Edward H. Harriman, the railroad man, has completed arrangements for the construction of a ten-mile private trolley line to his new million-dollar residence at Forest Lake, N. Y. The line will run from the Newburg Junction on the Erie Railroad through Tuxedo, and thence to Arden and the mountains above Greenwood Lake, where Mr. Harriman's summer home is to be located. The rolling stock will consist of two passenger cars, one of which will be a parlor car. It is expected that work on the road will begin in the spring.

CALCIUM STEEL.—United States Consul-General Mason, of Paris, reports that the so-called "calcium steel" is not any form of steel or any other metal, but a ceramic product, made by baking in an oven a paste made of finely pulverized feldspar, sand and lime in certain specified proportions. These materials, being mixed with water and worked into a plastic paste resembling sculptor's clay, and then baked, produce a porcelain or earthenware of great hardness and durability, which resists corrosion by acids, or alteration by atmospheric influence, is a poor conductor of heat or electricity, has a specific gravity of 3.3, and is in color a yellowish white, which may be varied to any desired tint by the addition of metallic oxides. By reason of its hardness and a certain toughness it can be bored, cut, planed or polished—qualities which generally belong to metals rather than ceramics. So far as can be ascertained, it has not yet become an industrial product of any great importance, although cheap, easy of manufacture, tough and exceeding resistance to acids, moisture and other deteriorating influences.

LIGHTING IN NEW YORK.—At a meeting of the New York Board of Aldermen on February 14, the finance committee submitted a report rejecting a resolution passed by the Board of Estimate and Apportionment appropriating $10,000 in addition to the $600,000 appropriated last year for the purchase of land for municipal electric lighting plants. The committee stated in its report that it was unable to obtain information showing that the land was worth as much as it was proposed to pay for it. The committee of engineers appointed to select sites and arrange for the construction of the plants, purchased sites for all the boroughs except Richmond, and needed $10,000 more to complete their work. Chief Engineer Lewis said at the time that, with this additional appropriation, the committee's work would soon be completed and the city could go ahead with the construction of the plants. The report of the finance committee against the appropriation was adopted by a vote of 51 to 10, involving a virtual abandonment of the municipal lighting plan, as the $600,000 appropriation is entirely exhausted and the engineers cannot continue the work for which they were appointed.

Electrical Engineers of the Times.—XLVII.

MR. W. H. MERRILL, JR.

William Henry Merrill, Jr., was born January 10, 1868, at Warsaw, N. Y., and educated in Holderness School, Plymouth, N. H., and the Massachusetts Institute of Technology, Boston, from which latter he was graduated with the class of '89. Upon graduation he became connected with underwriters' electrical inspection work in Boston, and in 1893 went to Chicago, where the following year he started in a very small way what has, under his supervision, now grown to be the Underwriters' Laboratories of the National Board of Fire Underwriters, where all the testing of electrical and other apparatus for the benefit of fire underwriters of the United States is carried on. The history of Mr. Merrill's engineering work is practically identical with the history of underwriters' inspection and testing since that time.

The Underwriters' Laboratories soon outgrew the cramped quarters in the down-town district of Chicago and were moved to a location on East Twenty-first Street. In 1905 a large model fireproof building was erected at East Ohio Street on the lake shore. The Underwriters' Laboratories, Inc., of which Mr. Merrill is the secretary, is the testing station of the National Board of Fire Underwriters. Its purpose is to examine and test all devices and materials affecting the fire hazard. The principal work of this institution is the testing of fire extinguishing and retarding devices, but an important department is devoted to the testing of electrical fittings. It is the best equipped laboratory plant of the kind in the world and is constantly extending its work through affiliation with important insurance organiza-

W. H. MERRILL, JR.

tions, manufacturers' associations, municipal departments and manufacturing companies. Mr. Merrill is also secretary of the National Fire Protection Association, which includes in its membership all of the insurance boards and organizations in the United States and Canada, as well as the American Institute of Architects, American Society of Mechanical Engineers, American Water Works Association and other national societies. It compiles all of the rules of the National Board of Fire Underwriters covering fire protection subjects and is the most important organization engaged in engineering work affecting the insurance interests. He is also secretary of the committee of consulting engineers of the National Board of Fire Underwriters, having in charge for that body the engineering work covering gas, oil and all hazards except electricity. He is chief electrician of the Electrical Bureau of the National Board of Fire Underwriters, supervising the electrical inspection service in twenty central western states and territories and having in charge the compilation and publication of the quarterly reports of electrical fires for the United States. Mr. Merrill is also a member of the electrical committee of the Underwriters' National Electric Association and of the National Conference on standard wiring rules, which organizations have in charge the compilation of the National Electrical Code.

The District Supply System of the North Shore Electric Company, Near Chicago.

IN the summer of 1902 Mr. Samuel Insull, president of the Chicago Edison Company, began the acquisition of the various electrical plants operating in the suburbs of Chicago, having in mind their consolidation under one management and the generating of the necessary current in stations of sufficient size to operate economically.

The company organized to carry on this work is known as the North Shore Electric Company and has the following officers: Mr. Frank J. Baker, vice-president and general manager; Mr. F. W. Insull, secretary and treasurer, and Mr. George H. Lukes, general superintendent.

Originally controlling a small part of the north shore suburban territory, the company has extended until now it owns the largest system of district, or village to village, electrical distribution in the Middle West. It controls practically all the suburban lighting around Chicago, and by so doing has made it possible to supply electric light and power to a number of small suburban towns

FIG. 1.—MAP OF NORTH SHORE ELECTRIC COMPANY'S SYSTEM.

where a purely local plant would not have been able to operate profitably.

As the suburban territory around Chicago is certain to have a large and rapid growth, high standards of construction have been adhered to; much higher, in fact, than would be justified in rural communities where no such rapid growth is sure to take place. The general engineering methods are naturally those of the Chicago Edison and the Commonwealth Electric Companies operating in Chicago, of which Mr. Insull is president, but of course many modifications have been introduced in these methods to suit them to suburban work where the load is more scattered than in the city.

The extent of the company's system can be seen by the map, Fig. 1, which shows in diagram the location of this company's generating stations, sub-stations and transmission lines. It will be seen that the company's distributing systems extend from Waukegan, 37 miles north of the business district of Chicago, to Chicago Heights and Crete, about 30 miles south. The general plan adopted has been to transmit from the generating stations to sub-stations over three-phase, 60-cycle, 10,000-volt, high-tension lines. These high-tension lines have been constructed with the intention of raising the voltage to 20,000 when the load increases enough to necessitate it. At the various sub-stations static transformers are placed, which step-down from 10,000 to 2,300 volts. The local distribution from each sub-station is by means of a 2,300-volt, four-wire, three-phase, 60-cycle system. By this system the secondaries of the sub-station transformers are Y-connected. Between the neutral point and the outer wires 2,300 volts is obtained, and between any two outer wires 4,000 volts. This gives a three-phase circuit at 4,000 volts for power purposes and 2,300-volt, single-phase circuits for lighting distribution.

Referring again to the map, Fig. 1, and beginning at the extreme north, it is seen that a generating station is located at Waukegan. The Waukegan station supplies by ordinary 2,300-volt distribution the towns of North Chicago, Lake Bluff, Rondout and Libertyville, taking a maximum or peak load of about 400 kw. At Highland Park is another generating station, the peak load upon which is about 475 kw. This supplies Highland Park, Lake Forest, Fort Sheridan, Highwood, Ravinia and Glencoe. This station is connected by a transmission line to a generating station at Evanston. The Highland Park station is operated only during part of the day, and it is the intenton to do away with the operation of the steam plant there and make it purely a sub-station as soon as possible. The company finds that stations operated to carry a peak load only are expensive luxuries and to be avoided as far as possible, although it is well to keep the steam machinery as a reserve for use in case of breakdown. At Evanston the company has two plants, from one of which hot water heating is supplied. These two plants carry a peak load of 800 kw and supply Evanston, Wilmette, Gross Point and Niles Center by a 2,300-volt distribution. The Evanston stations carry all of the load at Highland Park except during the peak. It is proposed to build a transmission line from Highland Park to Waukegan and to erect a large economical generating station on the lake shore at Waukegan. Thus the Waukegan and Evanston plants will be connected by transmission lines and it will be possible to carry much of the load of the north shore suburbs from the Waukegan plant, although on account of the hot water heating business in Evanston and the large load there, the generating stations in Evanston cannot be abandoned.

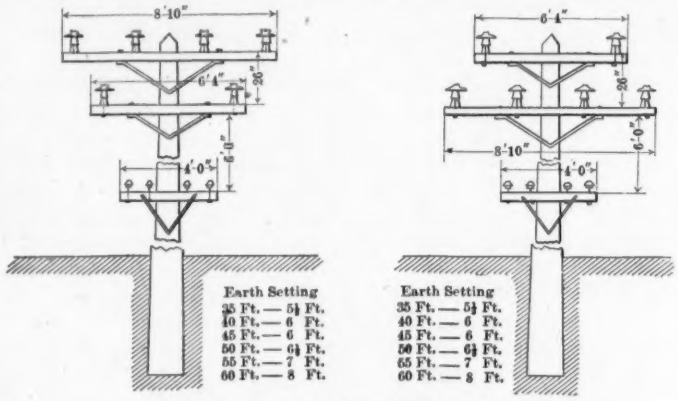
From Evanston a transmission line runs to a sub-station at Park Ridge, upon which there is a maximum load of 150 kw. From this sub-station the suburbs of Des Plaines, Park Ridge, Edison Park, Norwood Park, Jefferson Park and Edgebrook are supplied.

The next generating station is at Maywood, where a new plant is being erected, as it is in the center of the important suburban district directly west of Chicago. The transmission line will soon be completed between Maywood and the Park Ridge sub-station, thus connecting Maywood with Evanston. The Maywood station supplies Maywood, River Forest, Harlem, Melrose Park and Elmhurst, all by 2,300-volt distribution except the line to Elmhurst, which is operated at 5,000 volts with step-down transformers at Elmhurst, reducing to 2,300 volts. The street lighting at Elmhurst is by 32-cp incandescent lamps supplied from a low-tension, multiple distribution, the street lighting transmission line being switched on and off at the power station at Maywood. The peak load on Maywood is about 250 kw, but this does not include the power to be supplied from there over the transmission line to La Grange.

From Maywood to La Grange is a 10,000-volt transmission line, recently constructed for the purpose of making it possible to shut down the steam plant of the La Grange Service Company and operate it as a sub-station. This is another combined water and lighting plant. Centrifugal pumps with vertical shafts built by the Byron-Jackson Machine Works in San Francisco will be used for this pumping. These pumps have been extensively used for the pumping of irrigation water and in mines, operating against very high heads, in California. The peak load at La Grange is about 250 kw. From this sub-station La Grange, La Grange Park, Grossdale and West Grossdale are supplied by 2,300-volt lines. From La Grange to Blue Island there is a long stretch

of country containing no suburban towns of much consequence. Probably some day a transmission line will be built connecting the southern suburbs with La Grange.

At the present time there is a combined electric light and water pumping plant at Harvey and an electric light plant at Chicago Heights. These two towns are connected by a transmission line and one or both stations operated as suits the company's convenience. The heaviest load is at Chicago Heights, but it is necessary to operate the Harvey steam plant continuously at present on account of the water pumping. It is now proposed to build a steam plant at Blue Island on the Calumet River. This will be a steam turbine condensing plant of good size, for supplying Chicago Heights and Harvey, and also furnishing energy to the Chicago & Southern Traction Company, which now controls the electric railway line from Harvey to Sixty-third Street, Chicago, and is constructing south from Harvey through Chicago



FIGS. 2 AND 3.—DIAGRAMS OF POLES.

Heights to Kankakee. From Harvey the towns of Thornton, Homewood and Flossmoor are supplied at 2,300 volts, and from Chicago Heights 2,300-volt lines are run to Steger and Crete. The peak load at Harvey is 150 kw, and that at Chicago Heights 400 kw. From this map and description it is seen that the company supplies a very large territory, and that when the transmission lines which it is proposed to construct immediately are completed, the generating stations will be so interconnected that the load can be distributed between them in an economical manner, and the possibilities of interruption to service reduced to a minimum.

Fig. 2 shows the standard pole line construction used for the high-tension lines connecting generating and sub-stations. As before explained, these lines are now operated at 10,000 volts with the idea of increasing this voltage ultimately to 20,000 volts. As all the details of construction are specified on the drawing, very little explanation is necessary. The insulators are porcelain, Locke No. 408A, on the line which is now being constructed. These are larger than many that are commonly used on 20,000-volt lines, so that there is a good factor of safety. The lower cross arm carries four telephone wires. Although these pole lines are constructed for two transmission circuits, only one circuit has been placed on any of them so far. The ordinary length of pole in the country is 40 ft. This length is, of course, varied to suit conditions. Thirty-five-ft. poles would do ordinarily in the country but for the fact that most of the company's transmission lines have also 2,300-volt distributing circuits on lower cross arms. The smallest wire that will be used on transmission lines in the future is No. 3 hard-drawn copper, this minimum size being used to secure mechanical strength. The telephone lines are No. 12 hard-drawn copper.

Fig. 3 shows the standard transmission line construction at a transposition. The telephone line is transposed every five poles on Locke No. 7 insulators.

Fig. 4 shows the standard construction at corners for the transmission and telephone lines.

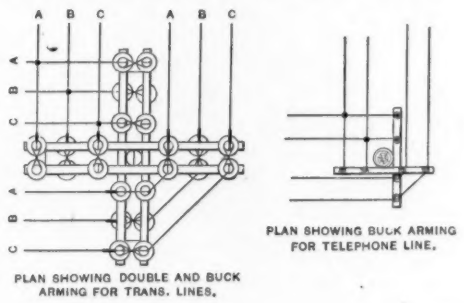
The present lines are mainly located on highways for which franchises had to be secured as well as the consent of the property owners along the route. In a few places the company has purchased consent to set poles on private property. After considerable experience with the right-of-way question, the company has come to the conclusion that in general it is better to secure private right-of-way, rather than build on the highway.

The general plan of operation is to keep the 2,300-volt bus-bar voltage constant at the sub-stations and to regulate the various single-phase lighting feeders with C. R. regulators, by which the voltage can be raised or lowered 10 per cent.

No fuses are used in the 2,300-volt distributing circuits save at the transformer terminals. Automatic circuit-breakers are provided on feeders at sub-stations. No time limits are placed on automatic circuit-breakers at sub-stations, but a time limit device is used on those at generating stations so as to give the circuit-breaker on any feeder time to act before that at the generating station will open and so prevent opening the station circuit-breaker in case of a heavy short-circuit on one feeder. The switch used on all 4,000-2,300-volt circuits is the type K3 oil switch of the General Electric Company.

The 10,000-volt transmission lines outgoing from power stations have General Electric type H3 switches and the incoming 10,000-volt lines at sub-stations have General Electric K6 switches.

Most of the sub-stations are of sufficient importance to justify the keeping of men on duty there twenty-four hours per day. The Park Ridge sub-station, however, which supplies a number of very small suburban towns, has an attendant only during the night when current is on. At present the company gives twenty-four-hour service in most of its territory. As soon as plans are complete, it will do so throughout all of it. The company maintains district offices at or near its stations and sub-stations. In small villages where there is no sub-station, arrangements for lamp renewals, etc., are made with some village store. Free lamp renewals are given. In Evanston and Waukegan, the two largest towns in the company's territory, a delivery service for lamps is maintained, although in some places an extra charge is made



PLAN SHOWING DOUBLE AND BUCK ARMING FOR TRANS. LINES.

PLAN SHOWING BUCK ARMING FOR TELEPHONE LINE.

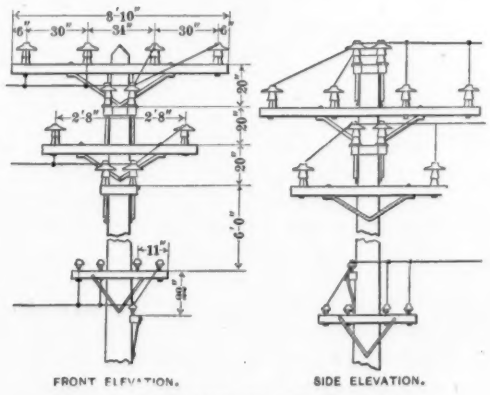


FIG. 4.—DIAGRAMS OF CORNER POLES.

for the delivery of lamps. As indicated by Mr. Baker, the vice-president, in a discussion at the last Illinois State Electric Association, the company finds that the policy of furnishing free lamp renewals is desirable in order to make sure that the customer's sockets are not filled with low-efficiency lamps purchased at Chicago department stores, and that the customer's do not neglect to renew burned-out lamps and so cause a loss of revenue to the company.

The company has its own telephone lines, carried on the transmission lines as indicated. Special attention has been given to the protection of telephone instruments, and a special cut-out with a very long enclosed fuse of No. 40 wire is used in each telephone circuit where it enters a building.

The Reincarnation of an Electrical Idea.

BY FRANK J. SPRAGUE.

IT has been only a few weeks since, in order to emphasize the fact that not only had we by no means reached the limit of direct current operation, but that we were within striking distance of working potentials which at first sight might seem startling, I venture to express myself as ready in case circumstances warranted to undertake heavy electric operation under a motor potential of not less than 1,500 volts. No sooner was this announcement made than all sorts of inquiries appeared as to how I proposed to do it, what was the meaning of this assertion, and, after all, were not the difficulties inherent to any such radical change greater than those to be anticipated in other departments of electric advance? I reserved to myself the privilege of explaining methods until the time of my own selection, and as to these details I hold myself still privileged, but perhaps I may as well call attention to a recent movement which has some bearing on the matter.

It is a curious circumstance that there should have been recently resuscitated and put into a practical working form, a method originally developed for the same purpose, and then, like many other good things, for the time being laid aside in the march of development along other lines. This particular instance is one of the most curious with which I am acquainted, and illustrates the fact that no thoroughly good idea is likely to remain forever buried, for the same reason which originally called it forth will again in the march of improvement demand its resurrection. And the particular idea which now bids fair to be of vital consequence, and utility in the further development of continuous current apparatus is that illustrated by the use of what are commonly known as commutating or inter-poles, but which in a broader sense may be termed the method of neutralizing armature reaction and eliminating sparking by automatically varying the polar resultant, or correcting the distortion due to varying relations between armature and field strengths in dynamo-electric machinery.

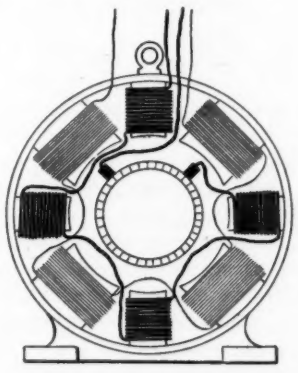


FIG. I.—INTER-POLE MOTOR.

In this specific form the commercial application of the inter-pole has been comparatively recent, but since this general method is one which is fundamental to the larger devlopment of non-sparking continuous-current machines operated at increased potentials, I derive more than ordinary satisfaction from the fact that both the idea and practice originated with me a good many years ago.

Among recent advertisements of one of the best-known American constructions the following paragraphs occur:

"What do you do when a motor begins to spark as the load comes on? You rock back the brushes because the point of best commutation has rocked backward. If this point of best commutation could be kept stationary and other conditions were right, the motor could be kept running without sparking and without shifting the brushes. Now that is exactly what occurs in the inter-pole motor. The inter-pole, midway between the main poles, being excited with series coils, weaken and strengthen with the load. Therefore, the resultant pole of the motor approaches the inter-pole when this is strengthened under heavy load and approaches the main pole under light loads. In other words, the field is automatically rocked back and forth, and, all other conditions being right, the brushes are always at the point of best commutation."

"When an inter-pole motor is speeded by the device of weakening the main fields, the motor calls for more current to maintain its increased speed and the armature tends to react strongly on the weakened main poles and twist the field backwards just as it does in the ordinary motor.

"It doesn't succeed in doing this because the strengthened inter-pole exerts its influence and brings the field and the non-sparking commutation point of the brushes forward where it belongs. What is the result?

"The inter-pole motor can be speeded 600 per cent over its slowest speed by field control and wth absolutely no sparking at the commutator.

"Reversing? That is simple. The armature circuit is reversed and with it the inter-pole, which simply reverses its function and helps out its left instead of its right-hand neighbor."

It is some years since there appeared in my United States patents, Nos. 428,732, May 27, 1890; 324,891, August 25, 1885, and 335,781, February 9, 1886, filed July 19, 1884, March 12, 1885, and September 26, 1885, respectively; also in a paper on "Electric Motors," read before the Naval Institute at Annapolis, Md., May 6, 1887, and in Chapter 13 of Martin and Wetzler's work, "The Electric Motor," published in 1886 and 1888, a complete description of the method of correcting sparking in direct-current machines by an automatically variable shifting of the field poles to offset the distortion set up by the armature. From the last-mentioned work the following is quoted:

"The winding of the field magnets of the motors is peculiar. One of the great difficulties which has invariably been met with in working with motors is the change of lead necessary to get the brushes at the point of non-sparking. It is considered necessary when dealing with large powers, if there is going to be continuous and successful running, to maintain the brushes at such a point. This change of the lead, caused by a distortion which is set up by the armature, varies with every change of load, with every change of the armature current, and with every change in the field magnet strength. It has furthermore been the habit where any considerable power has been developed to use two sets of brushes, one for forward and the other for backward motion. Mr. Sprague has entirely obviated the necessity for doing this by an arrangement which is as simple as it is efficient. This consists in the method of constructing, winding and connecting up the field magnets. The latter are wound with two sets of coils. One of these is a fine shunt coil which is in series with an independent regulating resistance and produces the normal poles; the other is a coarse coil in series with the armature, which tends to produce poles at right angles to the normal poles, and this circuit is included in the reversing switch so that when the armature circuit is reversed the current in the coarse coil is also reversed. There are then four poles set up in this machine, two being normal and variable at will, the other two being abnormal variable poles dependent upon the current flowing through the armature.

"In the normal arrangement of circuits the two sets of field coils, fine and coarse, combine to set up a resultant polar line which is distorted or rotated in the plane of rotation of the armature. Since any increase in the armature current causes the same increase in the series field coils, the tendency to distortion by these two elements will always vary to the same extent, and the resultant position will be always the same no matter what is the extent of variation of current. If the strength of the field magnet is varied independently of the armature, by changing the resistance in the shunt field circuit or by a variation of potential on the line, while there is a tendency to change the armature distortion, there is an equal and opposite tendency to change the distortion due to the series field coils, and so this, also, has no effect. If the direction of the armature current is changed so also is that of the current in the series field, and hence the direction of each distortion is changed; but they still oppose each other and vary equally and oppositely as before, and there is

still no change in the non-sparking points. It is immaterial whether the change in direction of armature current is due to a change of terminals in changing the direction of rotation of the motor, or is caused in changing the motor into a generator by strengthening the field. Hence the motor will run in either direction on a circuit of constant or varying potential, with a single or double set of tangential or end-contact brushes, with no necessity for changing the position of the brushes. The position of the brushes having been once properly adjusted, it is made independent of the amount of work the machine is doing, or the speed at which it runs, or whether it is acting as a dynamo or as a motor. It is likewise independent of the strength of field and of the armature current so long as the magnetic moment of the field sufficiently exceeds that of the armature."

Two claims from patent No. 335,781 are sufficiently illustrative:

"12. An electro-dynamic motor having series and shunt field coils arranged to produce polar lines at right angles to each other in combination with an adjustable resistance and a circuit reverser in the armature circuit, and an adjustable resistance in the shunt field circuit, substantially as set forth.

"13. An electro-dynamic motor having series and shunt field coils wound so that the series coils distort the poles set up by the shunt coils, in combination with means for reversing the direction of distortion, substantially as set forth."

These claims define the poles as being at "right angles" to each other, because biipolar machines were used with consequent pole windings, but the meaning of course is that the poles set up by the series coil are intermediate between and equidistant from those determined by the shunt winding.

In the stationary motors which I for some time constructed with double coils the series winding was a distorted one, and intended to shift the field in one direction only, but on motors installed and operated for some months in the year 1886 on the Thirty-fourth Street branch of the elevated railroad the series armature coil was equally distributed so as to tend to produce the supplemental poles equally midway between the normal ones. No actual polar projections at these points were used, but this is a physical not a fundamental difference; and, as stated, consequent not salient poles were used in these early constructions.

The actual construction of the fields and the winding of the series field coil, as well as its connection to the armature and reverser, are illustrated in the accompanying sketch.

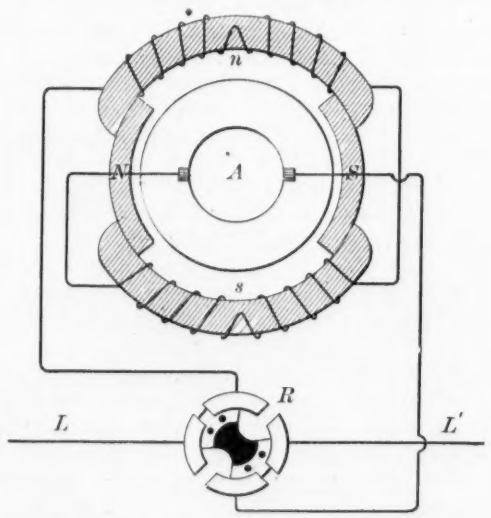


FIG. 2.—DIAGRAMMATIC SKETCH OF EARLY MOTOR.

The shunt winding, making the poles *N* and *S* is omitted for clearness. The variable supplemental poles are *n* and *s*.

The late Prof. Henry Rowland, in reporting upon the features distinguishing the early practice of the old Sprague Electric Railway & Motor Company, pronounced this a most important and valuable advance.

This general idea, since quite independently, I assume, conceived and applied to salient pole machines, bids fair to revolutionize much of the continuous-current practice, and is one of the principal features which I unhesitatingly assert is going to make possible very much higher potentials in direct-current machines. Those who have experimented with this development have been astonished with the results, and the freedom of design which it leaves in the hands of the constructor. Not only American but English and German manufacturers are rapidly becoming interested in it, and some of the possibilities are indicated in an interesting paper by Dettmar in a late article in the *Elek. Zeit.*, from which I quote the following brief extract:

"On account of the necessity for obtaining good commutation, direct-current dynamos have been built in the past mainly for electromotive forces not over 700 volts, for large generating sets not over 1,100 volts, and in extraordinary cases 2,000 volts have been employed. With the use of interpoles it will be easy to at least double the voltage. This should have an important effect on direct-current traction and simple power transmissions. * * * It may, therefore, be assumed that there will be a tendency in the future to make interpole construction the rule."

Of course this is but one element of the problem so far as railroad practice is concerned, and there are other important essentials. But the possible increase of potentials directly used on invidual motors to 1,500 volts, to say nothing of what may be used in combinations of motors, promises important developments in direct-current work. And when to this is added the fact that by special methods of regulation not only can there be a range of at least six or eight to one in economic speed under load, with the utmost refinement of variation, but that in addition where there are down grades the locomotives can be used to restore energy to the line through a complete range of like character, if the gain warrants the increased size and cost of apparatus common to all proposals for return of energy, some idea may be had of possible future developments.

Turning now to other types of machines, it is interesting to note somewhat further to what extent double fields are used. For example, in the normal commutatorless polyphase motor an essential element is the use of two equally displaced windings to create by alternating currents of differing phase two variable and reversible fields which combine into a resultant rotating field.

Again, the compensating coils used on some commutating types of alternating-current motors are really coils wound to create magnetic fluxes intermediate as to polar resultant between the normal poles, as illustrated by the Lamme motor described in the Electrical World of February 10, and in the diagram of the single-phase motors of the General Electric and other companies.

Referring again to direct-current practice, the development of this general method of neutralizing armature reaction is but one element of the problem so far as railroad practice is concerned, and there are other important essentials. But the possible increase of potentials directly used on individual motors to 1,500 volts, to say nothing of what may be used in combinations of motors, promises important developments in direct-current work. And when to this is added the fact that by special methods of regulaton not only can there be a range of at least six or eight to one in economic speed under load, with the utmost refinement of variation, but that in addition where there are down grades the locomotives can be used to restore energy to the line through a complete range of like character, if the gain warrants the increased size and cost of apparatus common to all proposals for return of energy, some idea may be had of possible future developments on direct-current lines, irrespective of whatever excellent results may be attained by direct alternating-current methods; all making to a common end, the greater development of heavy electric traction.

The Magnetism in Induction Motors.

By H. F. and H. W. Connell.

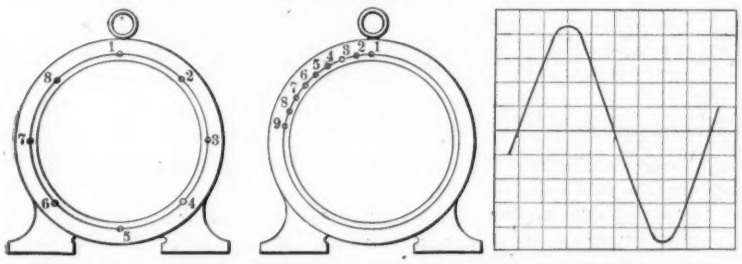
THE investigation which is outlined below was undertaken for the purpose of ascertaining how nearly the commercial induction motor of to-day follows the theoretical laws regarding the impressed e.m.f. wave form and its relation to the resultant wave form of the flux, both as to time value and space distribution. Although the results here obtained may have

no commercial value, they will nevertheless be of interest to the student and the designer in showing how nearly theory and practice agree.

Kapp, Blondell and others have shown theoretically that if the induction motor is subjected to sinusoidal e.m.f's the resultant time value of the flux in the air-gap will likewise be sinusoidal. It was with the object of observing if this condition held true in practice, and of ascertaining the space distribution of the flux in commercial machines running under actual working conditions, that the investigation was made.

The value of the flux was ascertained by the use of test coils placed on the induction motor, both around large arcs of the stator and also around single teeth of the stator, these coils being connected to a Rosa curve tracer. Therefore, the curves obtained are not entirely accurate as regards the form and the actual values of variation of flux, but they show the general form both as to its time value and space distribution. One of the principal causes of variation in the curves was the inability to keep the impressed e.m.f. at a constant value, due to poor governing of the engine.

The machines used in making the investigation were a four-pole, two-phase, 3-hp, 200-volt induction motor and a four-pole, single-phase, 1-hp, 100-volt induction motor.

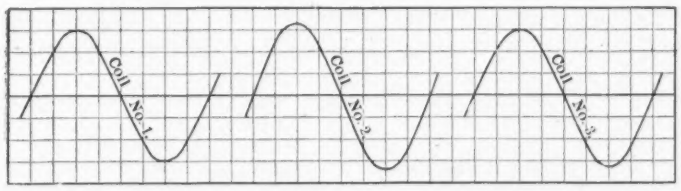


FIGS. 1, 2 AND 3.—ARRANGEMENT OF TEST COILS, AND WAVE OF E.M.F.

The impressed e.m.f. curve (Fig. 3) was observed by connecting a high non-inductive resistance to the source of supply of alternating current. A shunt was run from this resistance to the curve tracer, while the contact maker was driven by a synchronous motor connected to the same alternating-current mains. This curve it will be seen is approximately sinusoidal.

In order to ascertain the time value of the flux in various positions over the pole faces eight test coils were placed at equal distances, 45 mechanical degrees apart, around the circumference of the stator of the four-pole, single-phase motor, as shown in Fig. 1.

Observations were made of the time value of the flux in each of the eight test coils, the contact maker being revolved through a complete three hundred and sixty degrees for each set of

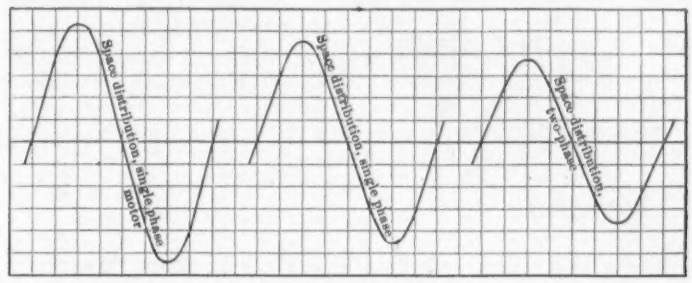


FIGS. 4, 5 AND 6.—TIME VALUE OF MAGNETIC FLUX OF SINGLE-PHASE MOTOR.

observations. Three of the curves of the flux when the induction motor was running light for coils 1, 2 and 3, respectively, are shown in Figs. 4, 5 and 6. Curves were also obtained when the machine was running under 9 per cent slip. These latter differed inappreciably from the former as to general form.

It will be seen from Figs. 4, 5 and 6 that there is a small variation in the maximum value of the flux in the different curves shown; also a smaller variation in the maximum value of the flux of the different legs of the same curve. As stated before, this is due almost entirely to poor governing of the engine. This variation does not, however, materially affect the worth of the curves, since it is the wave form in these curves that is desired, and not the numerical value of the flux.

In order to observe the space distribution of the flux over the pole faces of the stator, nine test coils were placed, equal distances apart, over one pole face, as shown in Fig. 2. The contact maker was then set at zero, and points of the curve were obtained by successively connecting the curve tracer to test coils 1, 2, 3, etc. Fig. 7 shows one of the curves which were obtained



FIGS. 7, 8 AND 9.—OBSERVED SPACE DISTRIBUTION OF FLUX IN SINGLE-PHASE AND TWO-PHASE MOTORS.

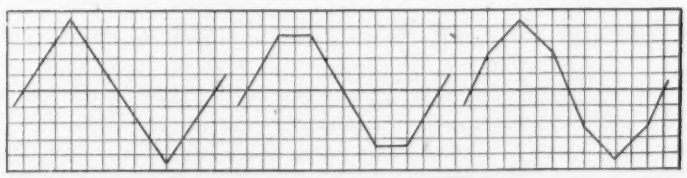
with the contact maker set at different positions throughout the 360° This curve shows the instantaneous value of the space distribution of the magnetism when the machine was running light.

Fig. 8 shows the space distribution of the magnetism when under load at 9 per cent slip. It will be noticed that these curves are sinusoidal.

The space distribution of the flux for the two-phase motor was found by using seven test coils, placed at equal distances over one pole face of the stator of the motor in a manner similar to that employed in obtaining the curves of space distribution for the single-phase motor. Fig. 9 shows one of the curves thus obtained. It was considered unnecessary to plot curves of the time value of the magnetism for the two-phase motor, since the curves of the single-phase motor showed what form of curve would have been obtained.

Figs. 10, 11 and 12 show theoretical space distribution curves as assumed by several well-known writers. Fig. 10 refers to a single-phase motor in which the winding covers the whole pole pitch, while Fig. 11 is for a single-phase motor when the winding covers two-thirds of the pole pitch. Fig. 12 refers to a three-phase motor. It will be seen that these assumed theoretical curves are not sine curves. An investigation of the flux distribution in the three-phase motor was not made. It was considered unnecessary, as the two-phase and three-phase motors are so nearly allied that the sine distribution of flux which obtained in the single-phase motor and in the two-phase motor would certainly hold in the three-phase motor.

It is frequently assumed that the space distribution of the flux is affected by the distribution of the winding over the pole pitch.



FIGS. 10, 11 AND 12—ASSUMED SPACE DISTRIBUTION OF FLUX IN SINGLE-PHASE AND THREE-PHASE MOTORS.

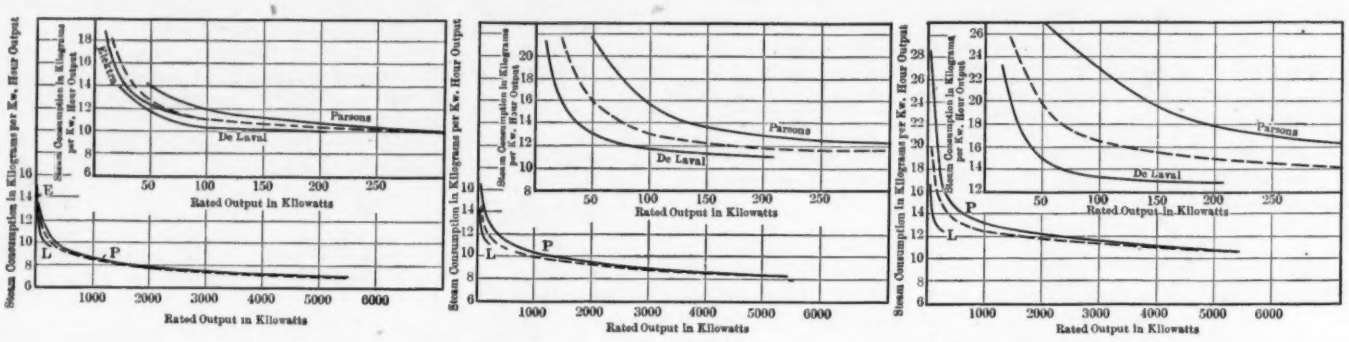
In this investigation such was not found to be the case. Neither was the form of the slot found to have any effect on the wave form.

The curves obtained from the investigation show that in the commercial induction motor there is a sinusoidal space distribution of the flux in the air-gap, when a sinusoidal e.m.f. is impressed upon the primary. It is apparent that in the induction motor the currents in the windings of the different phases, and in the rotor combine their magnetomotive forces so as to produce a sinusoidal flux in the air-gap, or, in other words, the different fluxes combine according to the ordinary laws of harmonic variation. It is evident also that the field is practically uniform except for small variations, due to the non-uniform reluctance of the iron.

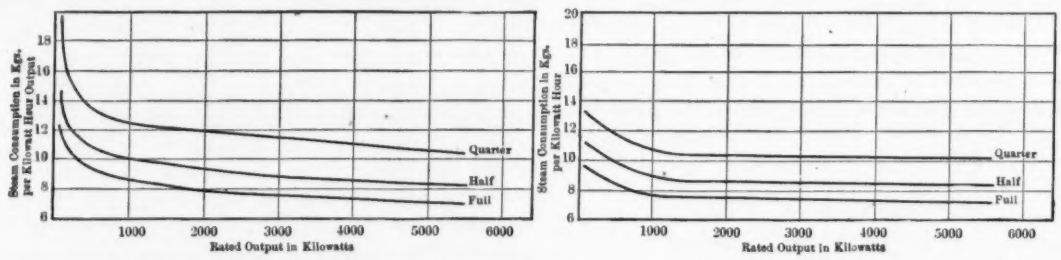
The Economy of Steam Turbines Compared With that of Reciprocating Engines.

By T. Stevens and H. M. Hobart.

THE comparative economy of reciprocating engines and steam turbines is a question of considerable interest at the present time. In instituting comparisons it is generally attempted to arrive at a broad conclusion in favor of one or the other type. The writers find, however, that the result depends very greatly upon the conditions of admission pressure, superheat and vacuum employed. The greater the first two of these quantities, the better showing does the reciprocating engine make in the comparison, while at high vacua and moderate or low pressures and superheats, the steam turbine excels over the reciprocating engine. This fact becomes evident from an analytical investigation of the published data of the two types. In an article which appeared in the issue of Electrical World for February 17, 1906, information was given concerning the steam consumption of modern reciprocating engines and curves were drawn to show the effect of changes in admission pressure, degrees of superheat and in the value of the vacuum. In the present article similar information is given concerning steam turbines, and comparisons are made between the relative behavior of reciprocating engines, and steam turbines with reference to the effect on the economy of varying the conditions of operation.



Figs. 1, 2 and 3.—Consumption of Parsons, De Laval and Elektra Steam Turbines.

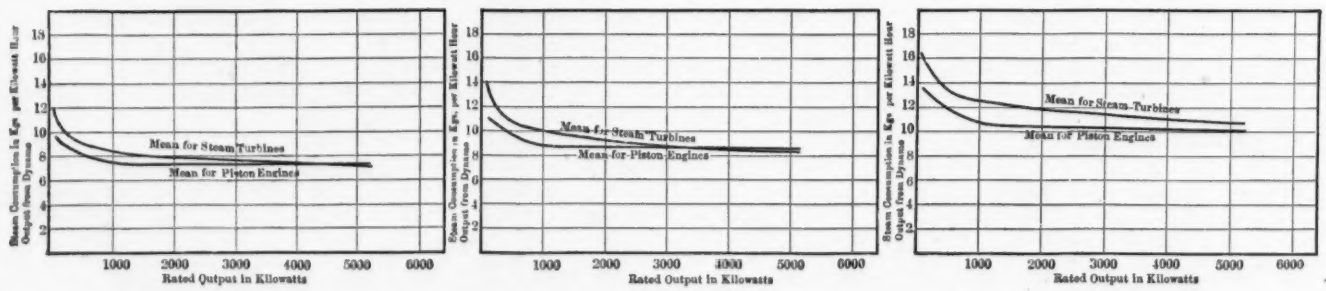


Figs. 4 and 5.—Consumption of Steam Turbines and Reciprocating Engines Under Standard Conditions.

In each of these three illustrations there has been drawn a dotted curve, which is considered to give, for practical purposes, a fair representation of the entire set of results. These dotted curves are reproduced in the three curves of Fig. 4, and are to be taken as representative, at full, half and quarter load respectively, of the steam consumption of steam turbines in general, for the present state of development. The corresponding results for good reciprocating engine practice are given in the three curves of Fig. 5. In Figs. 6, 7 and 8, relating respectively to full load, half load, and quarter load, there have been brought together the curves for steam turbines and reciprocating engines, corresponding to the standard pressure, temperature, and vacuum adopted in this article.

It is exceedingly difficult to make such a comparison, owing to the individual characteristics of the various types, not only of the reciprocating engines, but also of the steam turbines. Nevertheless, the conclusions given have been deduced only after a very thorough investigation, and it is believed that they indicate as good a general comparison between the two great classes of steam engines as can at present be arrived at.

Before developing for steam turbines a series of curves similar to those of Figs. 18 to 29, of the previous article, representing


Steam Consumption in Kg. per Kilowatt Hour Output from Dynamo
Rated Output in Kilowatts
Mean for Steam Turbines
Mean for Piston Engines

Figs. 6, 7 and 8.—Steam Consumptions for Steam Turbines and Engines of Various Outputs.

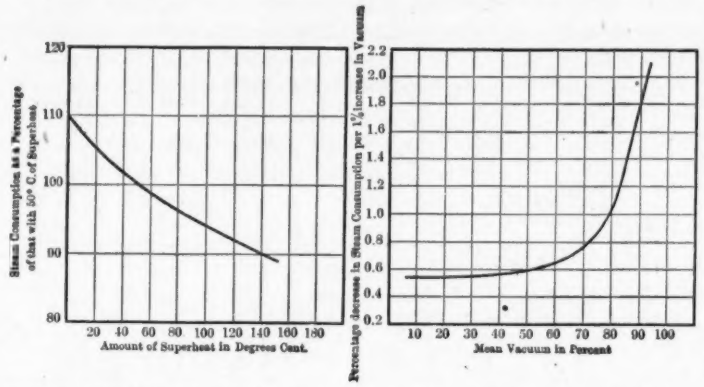
The results of such a large number of tests of steam turbines of the Parsons and the de Laval types have been published from time to time, that it is practicable to embody the conclusions in curves.* When these results are reduced to the standards of reference which has been chosen for this purpose, viz., an admission pressure of 13 absolute metric atmospheres, 50 degs. reciprocating engines, it is necessary to consider the influence of admission pressure, superheat, and vacuum on the steam consumption of turbines.

For the purpose of comparison between piston engines and turbines, as regards their respective steam economies, the treatment below is confined chiefly to the Parsons steam turbine, since the data and test results on this type are far more exhaustive than those on any other; and the range of capacity over

* A curve has also been added setting forth the values guaranteed for the Elektra type.

which tests have been made is greater. From these and other considerations, this type of steam turbine has been chosen as most suitable for the purpose of comparison with piston engines.

The economy of the Parsons type of turbine is influenced very slightly by variations in steam admission pressure; so


Steam Consumption as a Percentage of that with 50° C. of Superheat
Amount of Superheat in Degrees Cent.
Percentage decrease in Steam Consumption per 1% increase in Vacuum
Mean Vacuum in Percent

FIGS. 9 AND 10.—EFFECT OF CHANGES IN SUPERHEAT AND VACUUM.

slightly, in fact, as to render a diagram representing this influence of very little value.

In deriving curves of steam consumption for other than the assumed standard conditions of pressure, superheat and vacuum, the procedure will be as follows:

The effect of varying the admission pressure is taken in accordance with conclusions arrived at as the result of an exhaustive study of the published test data on the Parsons type of steam turbine. From these values the following rate of variation was estimated:

shows the effect of change in the vacuum on steam consumption of the Parsons turbine.

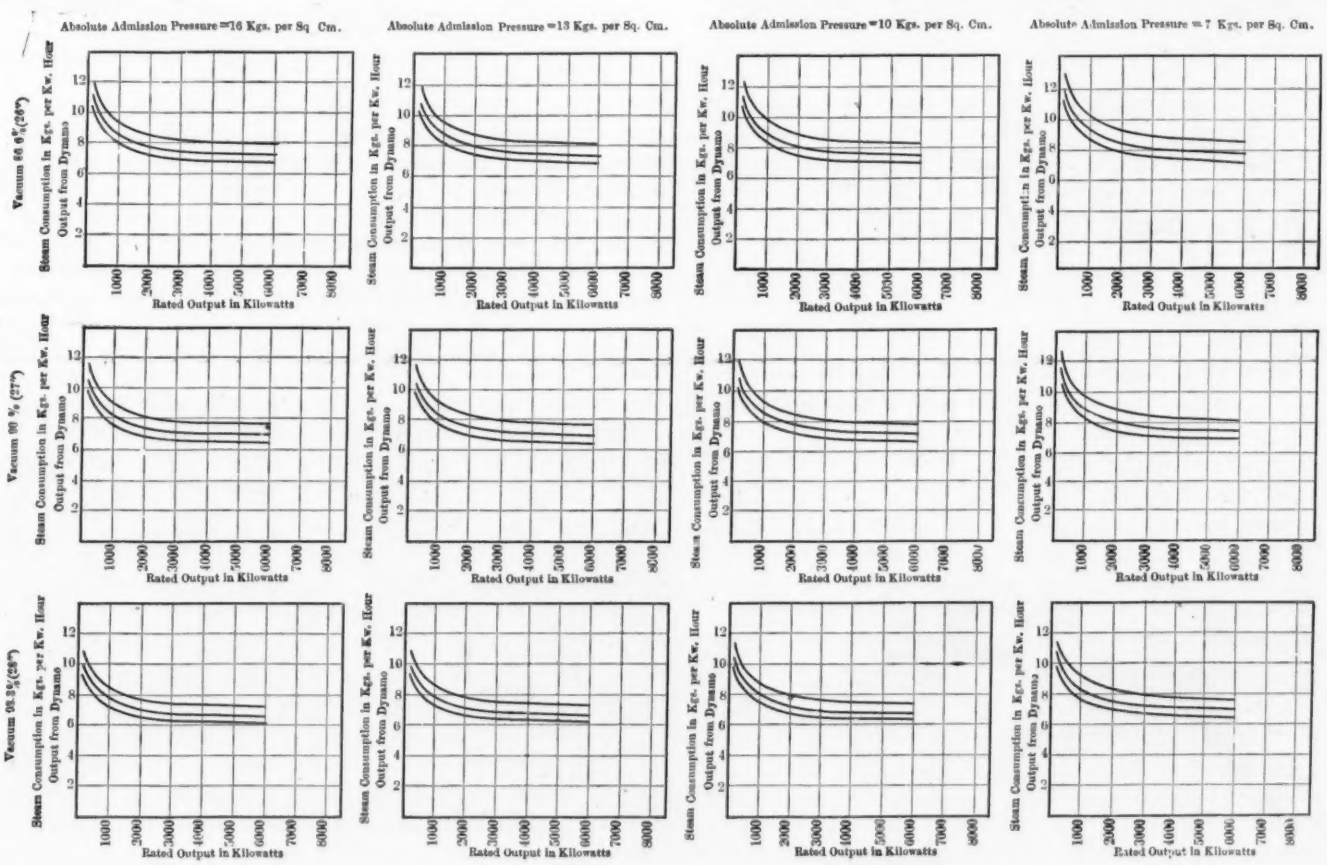
From these results have been derived the sets of curves in Figs. 11 to 22 inclusive.

In Figs. 23 to 30 have been brought together, for the purpose of comparison the full-load steam-consumption curves for piston engines and steam turbines, derived from the sets of curves in Figs. 18 to 29 of the former article and Figs. 11 to 22, given above. In the set of curves in Figs. 23 to 30, the steam consumptions have been considered only under the extreme conditions, namely, absolute admission pressures of 16 kgs. and 7 kgs. per sq. cm., vacuum of 93.3 per cent and 86.6 per cent, with superheats of 50° C. (Figs. 23 to 26) and of 100° C. (Figs. 27 to 30).

It will be well to describe briefly the curves represented in Figs. 31, 32 and 33. Throughout, the comparisons have been drawn exclusively between the full-load steam consumptions of piston engines and steam turbines. In Figs. 31, 32 and 33, however, an attempt has been made to represent in diagrammatic form the increase in steam consumption with the decrease of load. The abscissae indicate the load, the ordinates representing the steam consumption as a percentage of that at full-rated load.

Fig. 31 is confined to modern reciprocating engines. There are eight curves in all, representing the consumptions of nine different engines, ranging in capacity from 30 kw to 1600 kw. In addition to the actual consumption curves, two limit-curves have been drawn, fairly representing what may generally be considered as the highest and lowest consumptions at various loads.

Curve *IX* is for a 1,600-kw engine, and it will be noticed from the shape of the curve that the minimum steam consumption


Absolute Admission Pressure = 16 Kgs. per Sq. Cm.
Absolute Admission Pressure = 13 Kgs. per Sq. Cm.
Absolute Admission Pressure = 10 Kgs. per Sq. Cm.
Absolute Admission Pressure = 7 Kgs. per Sq. Cm.
Steam Consumption in Kgs. per Kw. Hour Output from Dynamo
Rated Output in Kilowatts

FIGS. 11 TO 22.—STEAM CONSUMPTION CURVES FOR STEAM TURBINES.

Decreasing the absolute admission pressure from 16 kgs. to 13 kgs. per sq. cm. increases the steam consumption by 1 per cent.

Decreasing the absolute admission pressure from 13 kgs. to 10 kgs. per sq. cm. increases the consumption by 2 per cent.

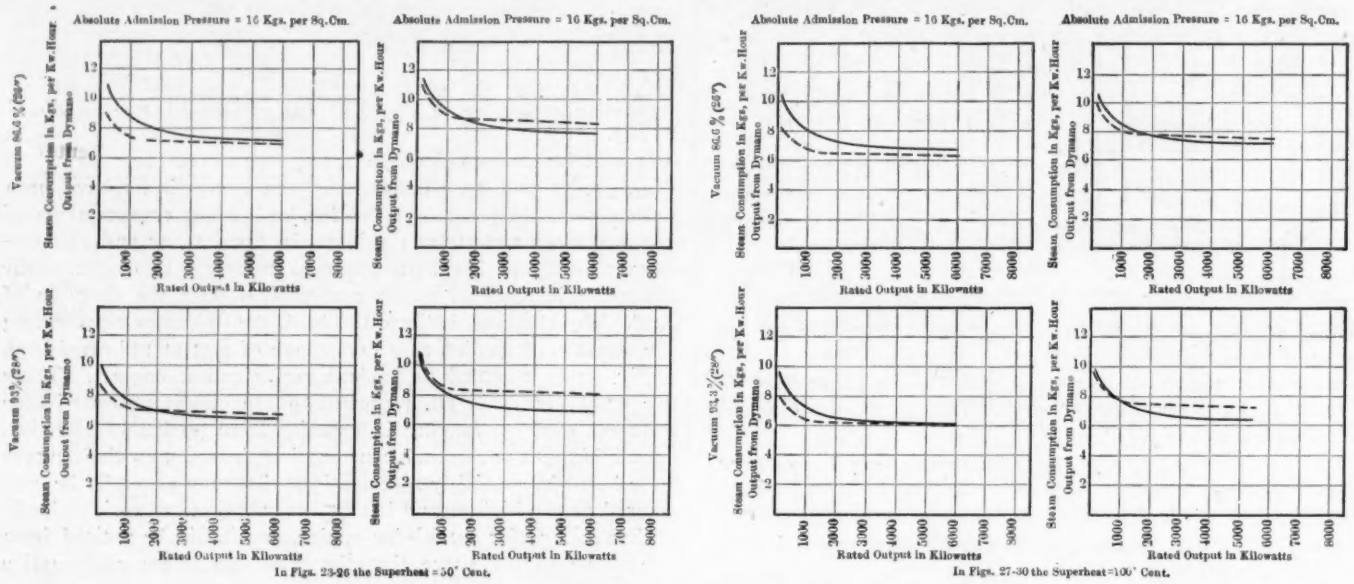
Decreasing the absolute admission pressure from 10 kgs. to 7 kgs. per sq. cm. increases the steam consumption by 4 per cent.

The influence of change in superheat on the steam consumption of the Parsons type of turbine is shown in Fig. 9. Fig. 10 occurs when the engine is running at about 5/8 of rated load. This is a desirable arrangement for engines whose average load is not over 3/4 of the rated full load.

Fig. 32 contains similar curves for steam consumptions of steam turbines ranging from 250-kw to 4,000-kw output. For reasons previously mentioned, only the Parsons type has been considered. In this figure, as in Fig. 31, upper and lower-limit curves have been drawn.

In Fig. 33 the limit-curves of Figs. 31 and 32 have been replotted, the dotted line representing reciprocating engines, the full line steam turbines. The areas enclosed have been shaded with vertical and horizontal lines respectively.

From this diagram it is obvious that there is practically no difference, so far as relates to these sets of tests, as regards the percentage of steam consumption at full load between the two types of steam engines. This diagram is instructive, inasmuch as it indicates graphically within what limits the steam consumption at various loads, expressed as a percentage of the full-load consumption, can be expected to lie.


Absolute Admission Pressure = 16 Kgs. per Sq.Cm.
Steam Consumption in Kgs. per Kw.Hour Output from Dynamo
Rated Output in Kilowatts
In Figs. 23-26 the Superheat = 50° Cent.
In Figs. 27-30 the Superheat = 100° Cent.

Figs. 23 to 30.—Full-Load Steam Consumptions of Reciprocating Engines and Steam Turbines Under Extreme Conditions.

Returning now to Figs. 23 to 30, it should be noticed that under the conditions of a good vacuum, and a low admission pressure, the steam turbine has certainly an advantage over the reciprocating engine. Generally speaking, the highest steam economies have been obtained with reciprocating engines, though, at the same time, a point very little inferior has been reached by turbines when working under favorable conditions. As can be seen from Figs. 23 to 30, it is a notable fact that the employment of superheat has a considerably greater influence on the steam consumption in the case of reciprocating engines than in that of turbines. With vacuum, however, the reverse is the case, the economy of the turbine being more beneficially affected by a high vacuum than is the economy of the piston engine.

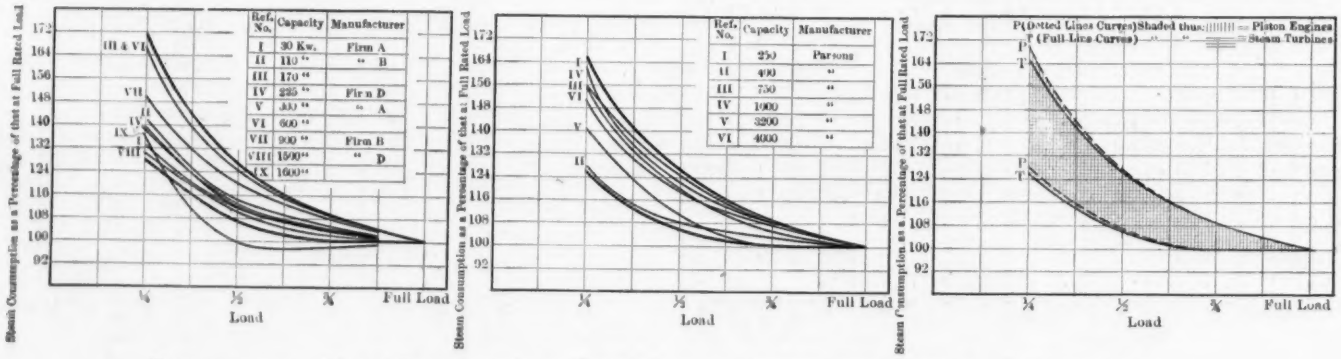
The forecasting of the future as regards the steam engine, whether of the turbine or reciprocating type, is by no means an easy matter; but one thing is certain, that the relative positions of the two types, so far as concerns steam consumption, will in the future depend to a very large extent upon the amount to which these especial characteristics are developed and utilized.

The characteristic of the steam turbine, in being but slightly dependent upon the admission pressure, undoubtedly opens a path for the future, deviating from that along which the development of the piston engine will advance. The probable tendency in future designs of steam turbines, for large sizes at any rate, will be to reduce the admission pressure, and therefore the saturation temperature, thus permitting of a greater range of superheat, and removing to some extent the difficulties now encountered when dealing with high temperatures. In the case of the reciprocating engine, whose steam economy is so greatly affected by the admission pressure, the amount of superheat used is limited, on account of the very high temperatures to be dealt with, owing to the high admission pressure.

There are certain obstacles in the way of the development of the steam turbine, consequent on the necessity of more perfect condensing plant. The initial outlay would thus be considerably increased, though there doubtless will follow a considerable advancement in the design of condensers, both as regards efficiency and cost.

So far, these remarks have related only to steam economy, though for an absolute comparison there are, of course, many other points which call for consideration. An exhaustive investigation from this point of view will not be attempted, but there is the question of oil economy, which affects the cases both of reciprocating engines and steam turbines, and is worthy of mention. In districts where the cost of coal is $3 (12 s.) per ton, the cost of oil will generally amount to some 8 per cent of the cost of coal in the case of good modern reciprocating engines It is claimed that for the operation of steam turbines the outlay for oil will be reduced to an almost negligible amount (0.5 per cent to 2 per cent). If the value be taken at 3 per cent for a district where coal costs $3 per ton, there remains a 5 per cent advantage for the steam turbine as far as relates to the combined outlay for coal and oil. Hence the turbine can afford to have an inferiority of 5 per cent in steam consumption.

It is too early as yet to attempt to arrive at any useful conclusions as to the relative rates of depreciation of the two types of engine.


Steam Consumption as a Percentage of that at Full Rated Load
Load
Full Load
Ref. No. | Capacity | Manufacturer
I 30 Kw. Firm A
II 110 " " B
III 170 "
IV 225 " Firm D
V 300 " " A
VI 600 "
VII 900 " Firm B
VIII 1500 " " D
IX 1600 "
I II III IV V VI
P (Dotted Lines Curves) Shaded thus: Piston Engines
T (Full Line Curves) " " Steam Turbines

Figs. 31 to 33.—Steam Consumption of Reciprocating Engines and Turbines at Various Loads.

The Testing Room of the Worcester Electric Light Company.

AN interesting example of testing room practice in central station work is found in the plant of the Worcester, Mass., Electric Light Company. Many of our readers are familiar with the Faraday Street station of this company, which was one of the first large urban lighting plants to be placed in service in New England, and which has always been operated with a close regard to first-class maintenance methods. In visiting the station to-day it is difficult to believe that it has been in constant operation for something like twenty years, so well kept is the equipment. During this time the apparatus has undergone various changes to enable the company to meet the altered requirements of recent years.

The original equipment was all belt-driven through countershafts, consisting of Thomson-Houston arc machines, 500-volt, direct-current generators and high-frequency composite-wound alternators. The idea of belt driving is still used at the plant in connection with the direct-current power and the Brush arc machines which have replaced the old T.-H. outfits, but the alternating-current service of the company is now provided by direct-connected, revolving-field units. New engines, boilers and a new stack have been added, all of these changes having been recorded in our columns at the time of their occurrence. The company has also invested heavily in underground construction, having a larger amount of duct than any other company in the State outside of Boston, and the voltage on the incandescent primaries has been raised from 1,100 to 2,200, the frequency of 60 cycles being adopted in place of the old high frequency of 133 periods.

In connection with the regular maintenance work of the company the daily testing of the circuits is an important duty. To facilitate this as much as possible, the tests are made in a special room 14 ft. long, 9 ft. wide and 16 ft. high, the room being closed in and set apart in one corner of the dynamo room. The test room was equipped according to the designs of Mr. Fred H. Smith, electrical engineer of the company, and its regular work is carried out under his immediate oversight. The switchboards at the Faraday Street plant are mounted in the center of the dynamo room and the test room is connected with the switchboard rear so that any circuit of the company can be brought in for testing.

The accompanying illustration (Fig. 1) is a view of the principal apparatus in the test room. An addition to this room contains a Queen cable testing set with D'Arsonval reflecting galvanometer and Wheatstone bridge, and six Bristol recording voltmeters. The Queen set is mounted upon a large marble table, wired up for immediate service. Auxiliary lighting is furnished by the company's regular 104-volt, 60-cycle circuit. The Queen set has proved most useful in testing the insulation resistance, capacity, leakage and general integrity of newly-installed underground cables The recording voltmeters are connected with the company's incandescent and alternating power bus-bars, one meter being connected across each phase, there being two sets of three-phase copper bus-bars on the alternating switchboard. The work done with the Queen set embraces the usual range of delicate measurements familiar to telegraph and cable companies, when the situation arises which calls for work of this character. In the main, the testing is done with the apparatus illustrated in Figs. 1 and 2, Fig. 2 being a special motor-generator set which is located in the dynamo room just without the testing room. Fig. 3 is a diagram of the connections of the apparatus, excluding the Queen cable testing set and the recording voltmeters.

FIG. 1.—TESTING ROOM.

In laying out the apparatus the idea constantly kept in mind was to provide a large number of testing combinations with the maximum simplicity of arrangement. The complication of connections is only apparent, and the actual work of making the daily tests is small, on account of the convenience of the layout. Referring to Fig. 3, and to the photograph, Fig. 1, *L L* are 16-cp, 104-volt incandescent lamps used for lighting purposes only, and operated from the leads cut in or out by switch *R*. On the bench at the left is a revolving reversing switch driven by a single-phase motor through gearing which reduces the speed from the vicinity of 1,800 r.p.m. to 4 r.p.m. The motor is operated from the 104-volt lighting circuit through a plug and socket connection as shown in the photograph.

FIG. 2.—MOTOR-GENERATOR TESTING SET.

Current for testing is drawn from the special motor-generator set, *X Y*. This set delivers from 50 to 500 volts direct current, the voltage control being effected through a separately excited field winding on the generator end of the machine. When the switch, *M* (Fig. 3), is thrown upward, the armatures are placed in multiple, the downward position throwing the armatures in series. The set was made by the Holtzer-Cabot Company and it runs at 1,170 r.p.m. The motor is a 550-volt, direct-current, shunt machine, rated at 3 hp. The switch, *M*, is located on a further wall of the test room and is not visible in the photograph. In Fig. 3, *N* is a 150 alternating-current-direct-current voltmeter, *O* and *Q* are 150-volt, direct-current instruments, and *P* is a 600-voltmeter for direct current. The testing room set also contains a 150-volt, 20-amp., Thomson indicating wattmeter, shown disconnected in Fig. 1; another 600-voltmeter, lamp bank, etc.

The apparatus on the wall consists of four 25-cp, series incandescent lamps, *A, B, C* and *D*, a terminal board carrying eight binding posts and two double-pole, single-throw switches, *E* and *F*, a double-pole, double-throw switch, *H*, and a single-throw, double-pole switch, *K*. Lamps *A* and *B* are mounted on a panel with a plug switch having four positions. In position 1 of the plug, lamps *A* and *B* are in series; at 2, *A* is cut in with *B* out; at 3, *A* and *B* are short-circuited, and at 4 *B* is in and *A* out of circuit. These lamps are used chiefly as direct indicators. Switch *E* throws direct current of from 50 to 500 volts upon the binding posts, 1 and 2, and thence upon the reversing switch through lamps *A* and *B* to binding post 3 and by direct wire to

post 5. From posts 3, 4 and 6 three leads are run to the rear of the main switchboard in the dynamo room. Post 5 is grounded and posts 7 and 8 are connected to voltmeter, *O*. Voltmeter *Q* is cut in across 6 and 8; voltmeter *P* is connected across 4 and 5 through the reversing switch, *H*, and a special tap is run between 5 and 7. From Fig. 1 it will be seen that these connections are in no sense arbitrary, but they can be altered to meet almost any conditions arising. A push button circuit, not shown, notifies the switchboard attendant what circuits to bring into the testing room according to a prearranged code of signals. The tests are made daily at 8 a.m.; arc circuits are tested for open condition hourly from the main switchboard.

The morning ground test on the arc circuits is made as follows: On receiving the bell signal the switchboard attendant touches plug 6 to the positive side of arc circuit No. 1. Switches *M*, *K* and *F* are closed meanwhile, throwing the potential of *X Y* upon the arc circuit through the voltmeter, *Q*. One side of the motor-generator set is always grounded, as shown in Fig. 3. The insulation of the arc circuit is, therefore, shown by the indication of the voltmeter needle, and a record of the reading is transcribed upon a test pad, which enables the condition of the feeder to be followed from day to day. As soon as the reading is taken the attendant at the switchboard is signalled to apply plug 6 to circuit No. 2, and so on. It is a great advantage to be able to apply such a wide range of potentials to the circuits, and with e.m.f's of one or two hundred volts, exceedingly definite results are at once apparent.

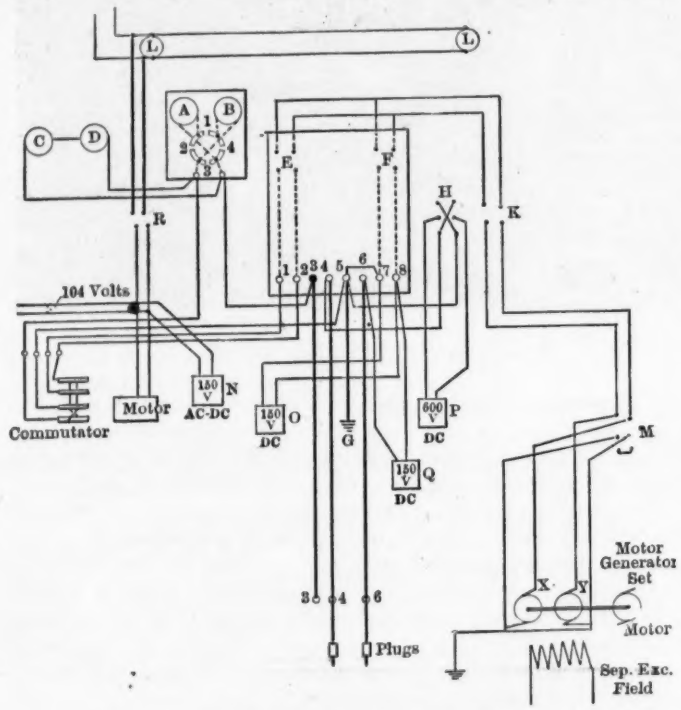


FIG. 3.—DIAGRAM OF CONNECTIONS, TEST ROOM.

In case an arc circuit is found to be grounded, say in the underground system between manholes somewhere on the line, the No. 3 load is connected permanently with one side of the arc circuit at the switchboard. This throws, when switches *E*, *K* and *M* are closed, the external arc circuit through lamps *A* and *B* upon the motor-generator potential, and as long as the ground exists the lamps will burn with a degree of brilliancy depending upon the applied voltage, circuit and ground resistance. Linemen now proceed to pass over the circuit with a horse and wagon, stopping every few manholes to apply a compass in the manhole just over the cable which is affected. The compass needle will deflect until the ground is passed, when it is located between two definite manholes, requiring but one cut in the cable. As soon as the ground is removed, or the cable cut, lamps *A* and *B* cease to burn, notifying the observer in the test room that the trouble is at an end.

In locating an open circuit in an arc circuit the lead No. 4 is grounded in the terminal room and No. 3 lead is touched to the unconnected side of the arc circuit, No. 4 being connected previously to the one side of the arc circuit. If a flash occurs it proves that the circuit is closed without the station. If there is no flash, the No. 3 lead is left connected, No. 4 is disconnected and linemen proceed to "cover" the circuit, stopping at intervals to ground the positive side. Throughout the city the right-hand side of the arc circuit, proceeding from the station, is positive. Each time the positive side is grounded momentarily by the lineman, a flash occurs at the point of contact, until the open circuit is passed, when no further flash occurs. Lamps *A* and *B* indicate the grounding at each point by glowing as the contact is made.

To determine the condition of a wire on a 500-volt power circuit without shutting off current, it is only necessary to apply the 600-voltmeter, *P*, to the circuit, one side at a time, the other side of the voltmeter being grounded. This is done by applying No. 4 lead to the power wire and reading, *P*.

The ground test on a dead power circuit is made by closing switches *M*, *K* and *F* and applying No. 6 lead to each side of the power circuit. This puts about 200 volts on the line to ground and the voltmeter, *Q*, is in series with the arrangement.

Ground tests on a dead alternating or power circuit are made by connecting the circuit at the station with the No. 3 lead, closing switches *E*, *K* and *M*. This enables current to flow continuously through the otherwise dead power circuit to ground and back to the generators, *X Y*. Linemen follow the cables with two compasses, applying each compass to one lead of the circuit. The deflections of the needles will be in the same direction until the ground is passed, when one of the needles reverses. Here also but one cut in the cable is necessary, between the various manholes. Short-circuits in power lines and connections are tested in much the same way, both sides of the line being connected with the special generator at the test room. When the short-circuit is approached the compass needle deflects; when it is passed there is no deflection.

The importance of regular tests in a central station of this character is not easily overestimated. Continuous service depends in a marked degree upon the watch which is kept upon the condition of the feeder system. The Worcester Electric Light Company now serves a population of about 130,000 people, operating some 1,200 hp in motors, 776 open arcs, 564 enclosed arcs and 68,100 incandescents. The officers of the company are: President, A. B. R. Sprague; treasurer, H. H. Fairbanks; superintendent and chief electrician, W. H. Coughlin.

The Lighting Problem in Residence Streets.

By H. S. Knowlton.

THE proper lighting of residence streets is one of the most difficult problems in modern central station practice. Except in the most thickly settled portions of the larger cities, it is not too much to say that the residential street lighting situation is to-day more unsatisfactory than that obtaining in any other application of electricity. The point is, not that electricity is unequal to the demands upon it, but that the communities served are rarely willing to pay for thoroughly good practice in the illumination of their residential streets.

From the standpoint of the municipality the lighting of scores or even hundreds of miles of residential streets is usually regarded as a heavy expense, whether the quality of illumination be good or bad. The per capita cost frequently reaches $1 per annum, but in comparison with the money expended per inhabitant for other public utilities the cost of street lighting is generally far from excessive. It is almost impossible to reduce to figures the decreased legal and punitive expenses which are brought about by the maintenance of a high standard of street illumination in any large town or city, but there is no doubt that crime is greatly lessened with well lighted thoroughfares.

It is out of the question to expect any residential street to be brilliantly lighted under the municipal appropriations common at the present time, but this does not mean that the problem

should be let alone by the central station manager who is anxious to extend his business by educating the public to a fuller appreciation of the possibilities of electricity in every phase of human activity. Doubtless every progressive manager would be only too glad to install additional lamps in the residence streets of his city if the necessary appropriation were forthcoming, but unless an organized effort to improve the situation is made, little can be accomplished. At the present time central stations are working hard to gain new business in many quarters, but very little has been done in the direction of street lighting expansion. An enormous field lies open to the manager who can convince the public that better street lighting and more of it is worth securing in the residence districts of nearly every American city. It is hopeless to expect much real assistance from the politicians, in this direction; the solution of the problem lies in creating a public demand for more extensive facilities.

In suggesting how this can be done it is realized that any increase in municipal expenses which the individual taxpayer feels is certain to produce great opposition unless it can be definitely shown that the increased expense results in vastly better service than the previous quality rendered. But two factors bear upon the matter which give good grounds for hope that some improvement may reasonably be expected. The first of these is the distinctly American characteristic of being willing to pay a fair price for good service of any kind, rather than a low price for inferior service; the second is the aroused public sentiment against municipal graft which manifested itself so emphatically in 1905. If, in any specific case, the public can be convinced that it will be getting its money's worth in a more extended and better distributed illumination of residential streets, it is more than probable that the entering wedge can be driven. Why should not some of the money which in previous years has been mulcted from the municipal treasury by the grafters be devoted under the improved conditions of to-day to securing the real public betterment of more extended street lighting?

Within the last two or three years great progress has been made in the production of higher illuminating efficiencies in low candle power units. The size of these units is admirably suited to the requirements of the average residential street, and in localities where the foliage is dense it would seem that the experimental equipment of a few representative streets with improved incandescents spaced sufficiently near together to give reasonably good lighting might be a valuable object lesson to the public. The magnetite arc lamp also offers much to the central station manager in the way of a more efficient and better distributed light for street service which is not hampered by too much foliage. It will not do to conclude that the public cannot be induced to buy more current for the lighting of residential districts simply because it has in the past failed to appropriate enough money to secure the results which a more liberal policy and the advance of electrical science would now make possible. In some cogent, forceful way there must be created a public demand for more lighting units in the residence streets. Many cities and towns are provided with progressive Boards of Trade, Improvement Associations, etc., which can readily be interested in so great a public benefit as the proper lighting of residence districts, and the co-operation of the newspapers ought not to be a difficult thing to secure, in starting the movement. There is no need to disguise the fact that the company intends to make a reasonable profit out of all new business which it secures, for no sane citizen will deny any square-dealing public service corporation a just return for its commodity.

It ought to be a simple matter to convince the public that the inadequate lighting of residential streets now conditioned by scanty appropriations is entirely out-of-date in the twentieth century scheme of living. The public demands, receives and pays for, in its urban transportation systems to-day, a service which is as far superior to that given by the horse cars of twenty years ago as the present precarious darkness of the average residence street in our cities and towns is inferior to the illumination of the business districts. The equipment of a single street along modern lines and comparative photographs of the old and the new street lighting arrangements, coupled with succinct statements as to costs, would be an object lesson worth having, and the time is certainly ripe for the new business departments of our modern central stations to see what can be done toward capturing this attractive and profitable field.

LETTER TO THE EDITORS.

Weight of Single-Phase Motors.

To the Editors of Electrical World:

SIRS:—I find that in the table accompanying the article entitled "Heavy Railroading," which appeared under my name in your issue of November 18, 1905, page 860, an error occurs concerning the single-phase motor of the General Electric Company. The data referring to the 75-hp single-phase motor of this company were partly taken from a publication in the *Street Railway Journal*, in which it was stated that the motor weighs 4,900 lb. (2,200 kg.), which I assumed to be the weight without gears. I am now informed that the motor without gears weighs 1,900 kg.

Similarly, I figured out from the gear ratio, wheel diameter and speed, the number of revolutions per minute, as 1,500, but I am now informed that this motor makes 700 r.p.m. at normal rated load. Accordingly the weight factor for this motor is about 180.

I note also that the article as printed might lead to the inference that I admit that the single-phase traction system is cheaper in first cost than the three-phase system owing to the use by the former of only a single contact conductor. In point of fact I showed by figures that this is not the case owing to the additional cost of the primary line, geenrating plant and especially the cost of the electrical equipment for the single-phase system. Again, in the part of the article treating of the superior economy of the three-phase system for lines requiring frequent stops, this claim is supported with reference to the single cascade connection, whereas my argument was based upon the multiple cascade connection.

BUDAPEST, HUNGARY. BELA VALATIN,
Electrical Engineer, Ganz & Co.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Design of Alternators.—WITTEK.—A paper illustrated by diagrams, discussing the design of alternators solely from the point of view of the voltage regulation without regard for the size of the machine. Formulas are developed and applied to numerical examples.—*Elek. und Masch.*, February 4.

Armature Reaction in Three-Phase Generators.—SUMEC.—The conclusion of his long mathematical paper, illustrated by diagrams, on the armature reaction in three-phase generators, with an account of the discussion which followed.—*Elek. und Masch.*, January 28.

Alternating-Current Commutator Motors.—NIETHAMMER.—The conclusion of his mathematical article giving the vector diagrams of different types of alternating-current commutator motors..—*Elek. und Masch.*, January 7.

Single-Phase Series Motor.—DICK.—A paper on the design of single-phase series motor for traction purposes. The author first explains why it is preferable to use a high speed in order to get small dimensions. Various formulas are given which should prove helpful to the designer and the use and design of special commutation poles is discussed at some length.—*Elek. und Masch.*, January 7, 14.

Armature Soldering Outfit.—POTTER.—An illustrated description of a soldering outfit for soldering armatures and a pneu-

matic press for pressing armature coils into shape, both of which devices have been developed at the Detroit United Railway repair shops.—*St. R'y Jour.*, February 3.

Lamps and Lighting.

Street Lighting.—Bloch.—An account of comparative tests made on street lighting in Berlin, partly with electric arc lamps, and partly with compressed gas (millennium light). The illumination in Friedrich Strasse (corresponding somewhat to Broadway in New York), is 6.8 lux, that of Alexander Strasse 5.2 lux. The exact measurements show that for a surface of street of 100 square meters (1,076 sq. ft.) each lux of mean horizontal illumination requires 8.4 watts with electric arc lamps, while with millennium light 50 litres of gas per hour are required for the same purpose. (To make the comparison complete it must be stated that in the tests the illumination by arc lamps was more uniform than with millennium light, so that the result would become more favorable to the arc lighting if by suspending the arc lamps at a lower level the character of the illumination would be made more similar to the illumination by gas. At special places in Berlin a much higher illumination is obtained, and in such places "intensive flame-arc lamps" are used. This is, for instance, the case on the Potsdam Square where two poles carry each four flame-arc lamps, each consuming 20 amperes. The lamps are provided with ordinary (not frosted) glass globes and are suspended at a height of 18 meters above the ground. The maximum illumination in this case is 82 lux and the mean illumination is 18.8 lux, the surface of the square being 3,640 square meters. This corresponds to a consumption of 6.5 watts for one lux and 100 square meters surface. This power consumption is much smaller than the value given above for ordinary arc lamps, but on the other hand the cost of maintenance is considerably higher with flame-arcs.—*Jour. f. Gasbel.*, February 3.

Negative Crater.—Reich.—An account of an experimental investigation of the size and the temperature of the negative crater of the electric arc.—*Phys. Zeit.*, February 1.

Lighting in Mines.—Anders.—A fully illustrated article on electric lighting in mines with descriptions of methods of wiring and accessories, etc.—*Glueckauf*, February 3.

New Metallic Filament Volume Lamp.—Kremsenezky.—An account of results of tests of the new metallic filament lamp of Hans Kuzel. A long abstract of this paper was published in our last issue.—*Elek. und Masch.*, February 4.

Power.

British Power Plant.—A description of the system of the Durham Collieries Electric Power Company. Cheap coal is available at the power plant and steam turbo-generators are used. Each turbo-generator has its own boilers, condensing plant and switch gear, which can be worked independently of any of the others. The engine room at present contains five main sets, all of the same size, three driven by Parsons turbines and the remaining two by Willans-Robinson turbines. The latter turbines are bolted down to their foundations and are rigidly coupled to their condensers, the latter being mounted on springs and provided with pipes, which are to a certain extent flexible, leading to the pumps. The Parsons machines are without holding-down bolts, and are connected with their condensers by flexible joints, the condensers themselves being rigidly bolted to their foundations. The alternators coupled to each turbine are of the high-speed, revolving-field type, running at 1,500 revolutions per minute. The normal output is 1,000 kw each. Three-phase currents are generated at 6,600 volts, the frequency being 50. Two auxiliary sets are provided, each consisting of one 180-kw direct-current generator, working at 550 to 600 volts for driving the various motors in the station and a 40-kw exciter on the same shaft. It is intended to put down two 400-kw, 550-volt Bruce-Peebles-Lacour "motor-converters," to supply power for traction. The load consists mainly of collieries, besides traction. Electric driving is applied for pumping, cutting, underground haulage, etc.—Lond. *Elec.*, January 26.

British Power Companies.—A table giving the maps of the areas of 23 British power companies which supply whole districts. For 10 of these companies, statistical data are given in a table concerning the history, system, equipment, tariff, etc.—Supplement to Lond. *Elec.*, January 26.

Gas Power.—Hoffman.—An illustrated article of a general nature on gas producers and gas engines and their use in electric stations.—*Elek. und Masch.*, February 4.

Elevators.—Klein.—A fully illustrated description of an electric elevator system used by a German company.—*Elek. Bahnen.*, January 4.

Coal Handling.—An illustrated description of the coal handling plant at the Willesden station of the Metropolitan Electric Supply Co.—Lond. *Elec.*, January 26.

Traction.

Electrification of Trunk Railways.—Leonard.—A note in which the author emphasizes his conviction that the replacement of steam locomotives by electric locomotives would be a paying proposition to-day upon a large percentage of our trunk line railways. The cost of electrification of steam railways will, of course, vary considerably, but it is probable that with the best systems of electrification the average cost will not exceed $60 per horse-power in the locomotive. On horse-power in the locomotive produces an output of about 13,000 ton-miles per annum on the existing railways. Based upon the average revenue per ton-mile in the United States, the earning power of the average United States locomotive is about $100 per hp-year. The total railway capital at present employed in the United States railways is about $600 per horse-power. The electrification of an average existing railway means an increase of its total capital by about 10 per cent, to provide the same total power as it now uses. If it be assumed than the ton-miles per annum on United States railways will increase, in the future, at the same rate as during the past ten years, and that the railways will be comprehensively electrified by 1925, it is estimated by the writer that not less than $1,200,000,000 of electrical apparatus will be required for this purpose alone during the next twenty years. When the construction of a new trunk line railway is considered, there is an enormous advantage in favor of electric traction over steam traction which is not properly appreciated. This is due to an inherent defect of the steam locomotive in that its power when hauling a certain train, falls off rapidly as the grade is increased. Also, simultaneously, the cost per horse-power rapidly increases. Enormous expenditures of capital are made in railway construction in order to escape the inefficiency of operation which would result from operating the steam locomotive on grades heavier than a certain limiting grade. The electric locomotive is one in which a voltage control of the speed is employed, and in which, as a consequence, the total power and the cost per hp-hour can be maintained constant over the range of tractive effort desired in practice. Other features of important superiority possessed by the electric locomotive are its ability to regenerate useful energy in going down grades and for breaking generally.—*St. R'y Jour.*, January 27.

Automatic Boosting.—Tilmey.—A paper read before the Birmingham section of the (Brit.) Inst. Elec. Eng. The author describes a system of automatic regulation of the shunt field circuit, the regulation being automatic both when the booster is charging and discharging; the apparatus is so arranged as to

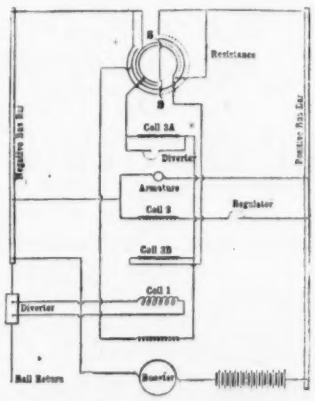


FIG. 1.—AUTOMATIC BOOSTING.

provide for reversal of the shunt excitation. The complete diagram of the arrangement showing booster and battery is given in Fig. 1, while the two diagrams in Fig. 2 show the multiple-way regulating and reversing switch and details of the same. This switch is mounted on a kind of table having all the resistances fixed underneath it. The switch-contact blocks are directly connected to the spindle of a small motor armature, which is caused to turn one way or the other from its neutral position by the interaction of the four field coils 1, 2, 3*A* and 3*B*. There are two pairs of contact blocks, one pair making contact on rings 1 and 2 and the other pair on rings 3 and 4. The reversal of the

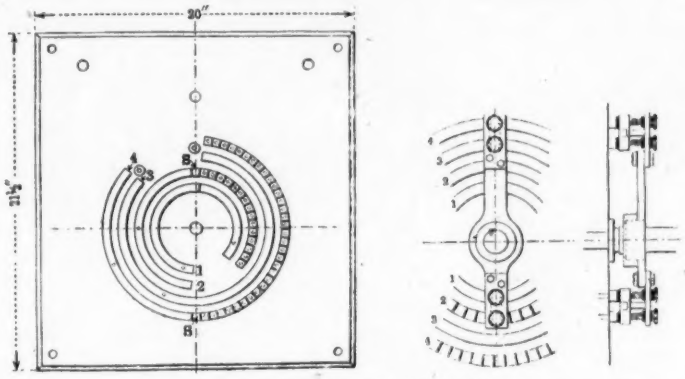


FIG. 2.—AUTOMATIC BOOSTING.

booster excitation and the discharge before reversal is effected by the two contacts marked *SS*, the switches, as they pass on to and over these contacts, short-circuiting the booster field windings. In practice, no sign of any inductive spark is visible, even with very rapid reversal. As the full boost is never required on discharge, there is a permanent resistance, as shown in the diagram, in series with the regulating resistance on the discharge side. The armature has a small current always passing through it. The field coils are in four different circuits: No. 1 carries a definite proportion of the outside load diverted through it by the main diverter. No. 2 is set to give a certain number of ampere-turns depending on the output of the machines running in the station, and this value of No. 2 coil has to be altered only when a machine is shut down or put on the bus-bars. Coil 3*A* is in the circuit of the booster field when the latter is charging the battery and coil 3*B* when it is discharging, the change from one to the other being effected by dividing the inside ring of the switch at the point where the booster field is short-circuited before reversal. Coil 3*A* has connected in parallel with it a small diverter which is to compensate for the rise in volts of the battery. The author gives some notes on the dimensioning of the coils with numerical examples. There was considerable discussion, an account of which is given. The author also gives some information on the results obtained with the regulator in actual practice at a British tramway station.—Lond. *Elec.*, January 26.

Traction in Great Britain.—Statistical tables giving a great many details on electric tramways and railways in the United Kingdom. There are three different tables, the first relating to the 114 tramways which are supplied from combined lighting and traction stations (11 more than last year); the second relating to 47 tramways which have their own power houses (2 more than last year); and the third referring to electric railways, of which there are now ten in operation and five more under construction. The 114 "combined" stations supply 1,190 miles of route (1,860 miles of single track), and the 47 tramways with their own power houses have a mileage of 780 miles of route, equivalent to 1,180 miles of single track. The former tramways possess 5,060 cars and the latter 4,360. On January 1, 1905 there were 1,770 route-miles of tramways in the United Kingdom, equivalent to 2,740 miles of single track. On January 1, 1906, there were 1,970 route-miles, equivalent to 3,040 miles of single-track—an increase of about 11 per cent in each case. Last year there were 106 route-miles of electrically-equipped railway, equivalent to 212 miles of track; this year 150 route-miles, or 285 miles of single track, an increase of 41 and 33 per cent respectively.—Lond. *Elec.*, February 2.

Tokio.—BALDWIN.—An illustrated description of the street railways of Tokio, Japan. The machinery was furnished by the General Electric Company, but the installation and operation were, and are, in the hands of Japanese engineers. The power plant contains three 1,200-kw alternators, generating three-phase currents, 6,600 volts at a frequency of 25, for transmission to two converter sub-stations. The use of the rails for the return current is forbidden by the government. It was, therefore, necessary to use two trolley wires.—*Elek. ahnen*, February 3.

London Subway.—The first part of an illustrated description of the Kingsway shallow-tunnel tramway. The conduit system is used, but the construction of the conduit is simpler and cheaper than on the surface roads.—Lond. *Elec.*, January 2.

Canal Haulage.—PERKINS.—An illustrated description of systems of electric canal haulage in use in Germany and in the United States.—*Iron Age*, February 15.

Lightning Protection.—TITUS.—A paper read before the Ohio Interurban Railway Assoc. giving a review of the present status of lightning protection on electric railways.—*St. R'y Jour.*, February 3.

Installation, Systems and Appliances.

Tariff Reform.—ROBERTS.—To introduce electric light to greater extent for private residence lighting a sound tariff must be applied. The writer thinks that for supplying small consumers both the flat rate and the maximum demand system are wrong. "Instead of lamenting their disadvantage as compared with the gas companies, who can equitably and, indeed, must measure their product by a meter, the central station engineers should be pleased that the business of electric supply does not require such a piece of apparatus. The argument in favor of charging solely by the amount of the maximum demand is growing stronger day by day as supply is getting into the hands of large companies whose variable costs are forming even smaller proportion of their total costs than before." The author recommends to let the consumer say what is the maximum number of lamps he wants to light altogether and make a charge at such per week, month or quarter as desired without installing any meter. In order to prevent the declared maximum being exceeded, a simple instrument can be used which will either cut off the current altogether or reduce it as desired.—Lond. *Elec. Times*, January 25.

Electrophysics and Magnetism.

Dielectric Strength of Air.—RUSSELL.—A long account of an experimental investigation in which the problems connected with the dielectric strength of air are discussed from all possible points of view. The author concludes that the dielectric strength of air at ordinary atmospheric pressure lies between 38,000 and 39,000 volts per centimeter, which is about 30 per cent greater than the value ordinarily given. J. J. Thompson gives the value as approximately 30 volts per cm. and M. O'Gorman as 27,000 per centimeter. "The confidence of electricians who are responsible for the working of high-pressure networks for the distribution of electric power on the working of their spark-gap safety-valves at the moment the pressure attains a definite value and the extensive use they make of micrometer spark-gaps for measuring high voltages, prove that under ordinary working conditions they find that the dielectric strength of air is approximately constant. In ordinary work we may take its value as 38 kilovolts per centimeter."—*Phil. Mag.*, February.

Inductance and Capacity.—HILPERT.—The first parts of a mathematical article. The author points out that the effects of inductance and capacity are analogous to the inertia effect of mass action in mechanical problems. Various electrical problems may, therefore, be discussed by the analogy with mechanical problems. The author deals with the increase in time of the current in circuits having self-induction and resistance or capacity and resistance and then describes graphical methods for determining heat effects in electrical processes.—*Elek. Bahnen*, January 24 and February 3.

Radiation.—A note stating that the Roentgen Society of London on a suggestion of Mr. Phillips considers the possibility of formulating a unit of radiant energy "which, while applying more strictly to radioactive bodies and other ionizing agents, may

be widened so as to include all known radiations." It is thought that presumably the intention is not to formulate a unit but rather a method of measurement. The general method of measuring radiant energy is to absorb the rays completely and to observe the rise of temperature of the absorbing matter. In the case of radio-active bodies and other ionizing agents, the difficulty is that there is no substance which will absorb the highly-penetrating rays in question. If, on the other hand, the intention is to solve the problem by comparing ionizing powers, it is still necessary to establish a law for every variety of radiation, connecting the radiant energy and the ionization it produces. This relation is not the same for alpha-rays as for gamma-rays, and is very different when, for instance, ultra-violet light and rays from radiant matter are in question.—Lond. *Elec.*, January 26.

Canal Rays.—Stark and Hermann.—An account of an experimental investigation of the spectrum of the light of the canal rays in nitrogen and hydrogen.—*Phys. Zeit.*, February 1.

Magnetic Hysteresis.—Duhem.—A second paper on magnetic hysteresis. The author discusses magnetization in a field which rapidly changes. In order to obtain the laws for this case, it is sufficient to consider the laws which govern the infinitely slow variations of the same magnetization and to substitute for the total magnetic field, the sum of this real magnetic field and of an imaginary magnetic field which is called the field of magnetic viscosity. The properties of the latter are derived from a consideration of viscosity in general.—*Revue Gen. des Sciences*, January 30.

Electrochemistry and Batteries.

Ore Dressing by Flotation.—An article giving abstracts of two recent Faraday Society papers. The joint authors of one are Swinburne and Rudorf. The author of the second paper is Huntington. The practice of the flotation process in the Broken Hill district is first discussed. The question then comes up as to the nature and origin of the gas causing flotation. The gas is carbon dioxide. According to Swinburne and Rudorf the phenomenon of flotation is one of capillarity. In a general way Huntington seems to hold the same opinion, although he criticises special points in Swinburne and Rudorf's theory. Electrification occurs during the process but Huntington was unable to obtain any evidence that it plays any direct part in the flotation.—*Electrochem. and Met. Ind.*, February.

Specific Resistance of Molten Steel.—Hering.—A communication correcting a mistake in a paper by Gin. Cast iron containing about 93 per cent iron and about 3 per cent each of carbon and manganese has a resistivity of 0.00016 ohm-centimeters at temperatures between 1,280° C. and 1,340° C.—*Electrochem. and Met. Ind.*, February.

Edison-Lalande Cell.—Arendt.—An article on a new type of the copper oxide-zinc primary cell, made by Wedekind. The special feature appears to be the preparation of the copper oxide. —*Elek. Zeit.*, January 11.

Units, Measurements and Instruments.

Devices Indicating Whether a Conductor Carries Current.—The Assoc. of French Mfgrs. against Accidents had offered prizes for the most suitable devices to indicate whether a line wire carries current. Eight devices were tested by Roux and Alliamet. The first prize was not granted to anyone. The second prize was given to Miet, his instrument being essentially an electroscope. A small glass tube, like a test tube in chemical laboratories, is closed with a rubber stopper through which a copper rod enters the tube. The outside terminal of the tube is a small copper sphere, while inside the tube the copper wire terminates in two thin aluminum leaves. If the copper sphere is held at a distance of two or three cm. from a 2,500-volt conductor, the aluminum leaves repel each other strongly. If the line carries 10,000 volts the instruments shows this at a distance of 10 cm. If the copper sphere is brought into contact with the line the instrument indicates a voltage of 100. The third prize was given to Taylor for an electric wheel. A glass globe of seven or eight cm. diameter contains an S-formed wire which rests on the point of a metallic rod. This metallic rod passed through a rubber support which closes the globe and the outside terminal of the rod is a sphere. If the sphere is brought into contact with the conductor-carrying current, the wire in the globe is charged and begins to rotate. This device indicates voltages above 7,000, and is well suitable for switchboards with bare metallic portions, while it is unsuitable for cables. For lower voltages Taylor has devised another instrument. This consists of a closed cylindrical glass tube which is filled with gasoline, a bronze powder being finely distributed throughout the liquid. A piece of metal is suspended in the liquid and is connected to a wire fused in the glass and terminating on the outside in a metallic bottom. If contact is made between the bottom and the conductor-carrying current, the metallic powder collects instantaneously at one place. The effectiveness of the device, which is less suitable for direct current than for alternating current, depends on the nature of the liquid and on the fineness of the metallic powder. Below 200 volts the indications are not certain. At 6,000 volts it is sufficient to bring the instrument near the conductor in order to produce at once the prescribed effect. An indicator by Thornton was recommended; It consists of a glass tube, closed on both sides with metallic caps and filled with petroleum in which are distributed carburized woolen threads. Metallic electrodes pass through the metal caps at the two ends into the tube. If the electrodes are connected between the conductors carrying the current the woolen threads assume a distinct direction and strong sparks occur between them, which are even visible in sunlight. An indicator by Knobloch consists essentially of an induction coil with iron fastened at the end of a rod. A telephone is connected with the coil. If by means of the rod the coil is brought near the conductor carrying alternating current one hears a sound in the telephone. The instrument is suitable only for alternating current of considerable intensity. Another proposition of Knobloch is to connect a voltmeter with adjustable rheostat between the conductor and earth. Schrottke of the Siemens-Schuckert Company proposes to insert a spark induction coil between an overhead conductor and earth. If the line carries current, sparks are produced and electric waves are emitted, by which coherers with relays are brought into operation. It is necessary to have a whole set of such oscillators and to choose the proper instrument according to the voltage.—*Elek. und Masch.*, January 28.

Street Photometer.—As a supplement to the paper by Harrison on street lighting which was recently abstracted in the Digest, the Harrison photometer is described by means of which an illumination measurement is taken in one direction only, and the screen is set at an angle of 45 deg. The construction is shown in Fig. 3. *S L* is the standard lamp, which can be moved vertically up and down the case until a balance is obtained. The mirror, *M*, reflects the light from this lamp on to the rotating screen, *F*, of the photometer proper. This is of the "Flicker" pattern, which facilitates measurements with illuminants of different colors. The screen which receives the illumination to be measured is inclined, at an angle of 45 deg., and the two illuminated surfaces are alternately presented to the eye of the observer through an eye-piece in the usual way. The battery feeding the standard lamp consists of four accumulator cells in non-spillable cases, contained in two compartments of the box, and permanently connected through a small press key to the lamp. When required the range of the instrument can be increased by the employment of two standard glow lamps of different candle-powers. A leveling arrangement enables the photometer screen to be set at an angle of exactly 4 deg. with the horizontal, and a lens and scale show at a glance the angle at which the rays from the source of light fall upon the screen. From a read-

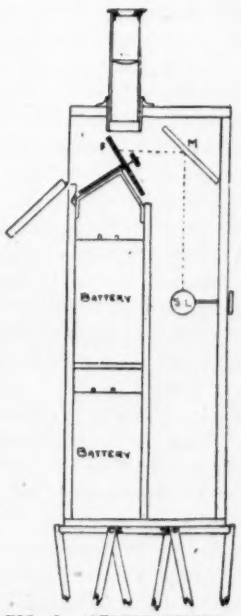


FIG. 3.—STREET PHOTOMETER.

ing taken in this way, representing the illumination on a surface inclined at 45 deg., either the horizontal or vertical illumination can be at once calculated. or, if required, the actual candle-power of the lamp in question.—Lond. *Elec.*, February 2.

High-Frequency Currents and Electric Waves.—FLEMING.—The first part of a full reprint of his second Cantor lecture on the measurement of high-frequency voltage.—Lond. *Elec.*, February 2.

Electrometer.—BENNDORF.—An illustrated description of a registering electrometer for measurements of air electricity.—*Phys. Zeit.*, February 1.

Telegraphy, Telephony and Signals.

Telephone Exchange.—A profusely illustrated description of the City Exchange of the British Post Office telephone system in London. It represents some new departures from modern British telephone practice. The subscribers' multiple has been abandoned on the answering positions of the exchange, and the 20 per cent of the incoming calls that are "local" are dealt with in a similar way to calls for subscribers in other exchanges. The reason for this is, not in order to unify the system of operating, but chiefly to render it possible to deal with a greater number of subscribers than hitherto in a single switchroom, and, secondly, to save a considerable item in the cost of wiring the switchboard. The practical limit of a subscriber's multiple has hitherto been 14,400 subscribers, and proposals to introduce a divided multiple with a selective calling key on the subscriber's instrument have not met with favor, nor has it been deemed advisable to reduce the size of the multiple jacks which are already reduced to ⅜-in. centers. Thus the method of confining the multiple to junction and transfer positions was adopted, and it is evident that further extensions can be dealt with almost to an unlimited extent by making suitable arrangements for dividing the multiple. An iron skeleton construction is used for the switchboards, and an independent connection is provided for each cord circuit to a main fuse board, a new pattern of cord having been adopted.—Lond. *Elec.* and Lond. *Elec. Rev.*, January 26.

BOOK REVIEW.

HANDBUCH DER ANGEWANDTEN PHYSIKALISCHEN CHEMIE. Vol. I. Electrochemie Wasseriger Losungen. By Dr. Fritz Foerster, Vol. II. Physikalisch-Chemische. By Dr. C. Doelter. Leipzig; Johann Ambrosius Barth. Vol. I, 507 pages, 121 illus. Price, 20 marks. Vol. II, 272 pages, 66 illus. Price, 12 marks.

Everybody who reads German admires the thoroughness of German treatises—the orderly presentation of the subject, the clearness of type, cleanness of appearance, and generally fresh and pleasing impression, which connotes the pleasure found in perusing the volume. Dr. Foerster's book is a model treatise; we wish there were anything half so good in English. After five short chapters on general principles, three on electrolytic theory, and one on galvanic cells, follows the special treatment in a chapter of 14 pages on the separation of oxygen and hydrogen, one of 38 pages on the behavior of electrodes, and secondary reactions, 63 pages on the applications to different metals, 43 pages on electrolytic reduction, 100 pages on the halgen elements, and 47 pages on electrolytic oxidation (perduction). The treatise is most admirably suited for use as a textbook in colleges, for self-instruction, and for reference. A translation into English would be "a consummation devoutly to be wished."

Dr. Doelter's book is a similarly thorough and painstaking compilation of work in an entirely different line, and work which is almost all very recent, because of the great advances made within the last decade. Mineralogy is sometimes regarded as a cut-and-dried finished science, to which is added from time to time the description of a few new and curious minerals found in some out-of-the-way corner; but anyone who merely glances through this treatise will quickly, yes, immediately, see that the very opposite is the case. Here we have nearly three hundred pages of applications of physical and chemical principles to the study of the formation and nature of minerals. Applications of the theory of solutions, entectic mixtures, phase rule, thermodynamic formulæ, decomposition tensions, lowering of the freezing point, raising of the boiling point, relations between chemical composition and physical properties—are only a few of the many absorbing topics discussed. This is the new mineralogy, the illuminating mineralogy, having about the same relation to the old descriptive mineralogy as a play of Shakespeare has to a dictionary of the English language. The publisher has done his part faultlessly.

Electrical Equipment of the Louisville & Nashville R. R. Shops.

An up-to-date example of the electrical equipment of railroad shops and in the application of the electric motor to all manner of power purposes is furnished by the new shops of the Louisville & Nashville R R. at South Louisville, Ky.

The generating plant consists of three 350-kw, 250-volt, Bullock generators (Fig. 1), direct-connected to cross-compound Buckeye engines running at 175 r.p.m. Steam at 125 lbs. pressure is supplied by a battery of Sterling boilers and equipped with mechanical stokers. The coal elevator is motor driven.

A transfer table having a bridge 100 ft. long and a transverse travel of 1,050 ft. is the center about which the buildings are grouped and serves as the connecting link to bind the various departments together. The bridge is operated by a railway motor capable of driving it at a speed of 12 miles per hour. By means of sliding clutches the motor may be disconnected from the bridge drive and connected to a drum to pull coaches and locomotives on to and off of the bridge.

Along the north side of the transfer table lies the largest building of the group, having a length of one thousand feet and including under one roof the boiler shop, the general machine shop, and the erecting shop. The south bay of this building is divided into 40 sections and every section has a track connecting with the transfer table. Eleven of these sections are in the boiler shop, which is separated from the erecting shop by a brick

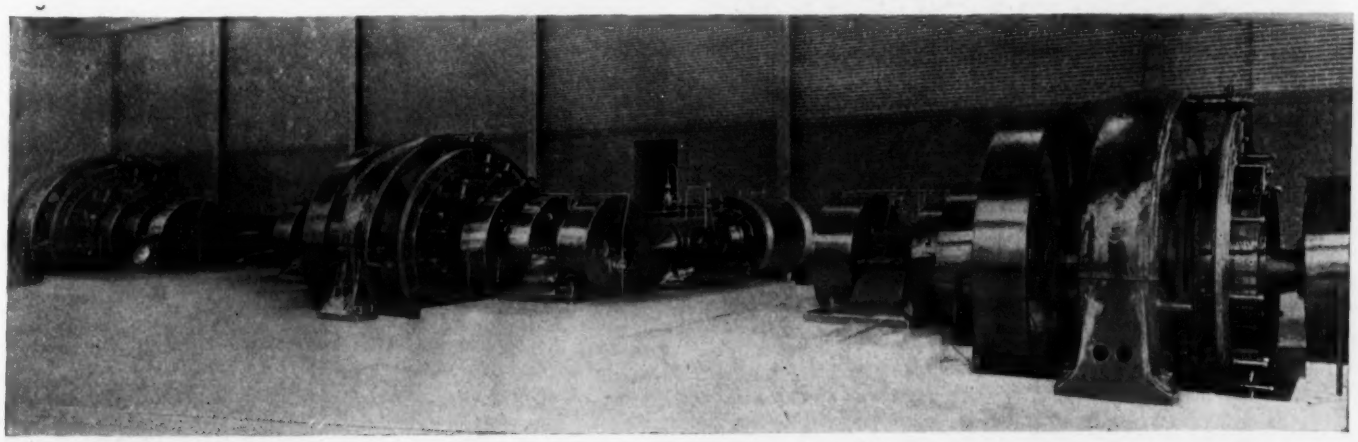


FIG. 1.—VIEW OF GENERATING PLANT.

wall 12 ft. high. The erecting floor is covered by a 100-ton crane provided with two trolleys and capable of carrying the largest sized locomotives from any part of the erecting shop over the wall into the boiler shop. A 10-ton crane on a lower runway serves to carry small parts, and these traveling cranes, of which there are eleven, are motor driven, the cranes being of the Niles Company's make.

In the machine shop the most extensive applications of electric

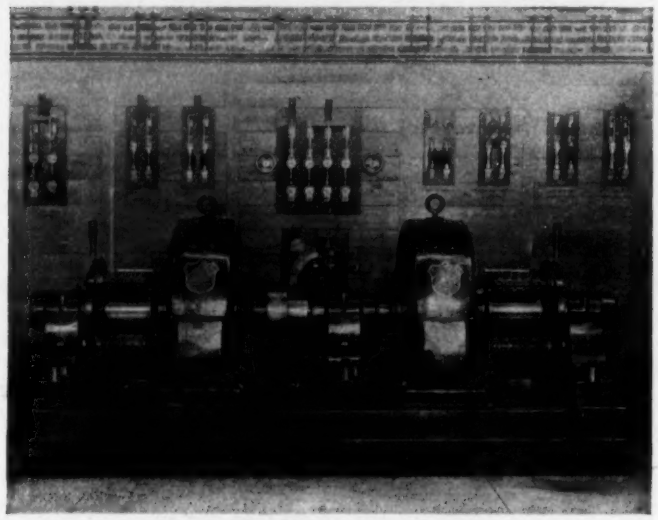


FIG. 2.—THREE-WIRE BALANCER.

drive are found. Near the middle of the shop is a switchboard controlling the various local feeders and connecting them to the mains running to the power house. Near the switchboard is located a Bullock three-wire, multiple-voltage balancer, shown in Fig. 2, which divides the 240 volts supplied by the mains into 100 and 140-volt circuits. A third wire, in addition to the generator mains, serves to supply three different voltages, viz., 100, 140 and 240 volts, to the motor's driving tools, which it is desired to operate at variable speeds. These different voltages are applied successively to the motor armatures by means of Bullock controllers, and intermediate speeds, and speeds above the nor-

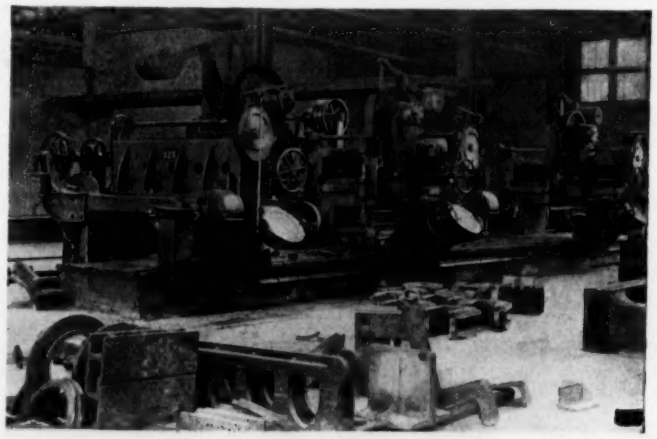


FIG. 3.—GROUP OF SLOTTERS.

mal at 240 volts, are obtained by the use of shunt-field resistance. The larger tools requiring variable speed are driven by individual Bullock three-wire, variable-speed motors, mostly direct-connected to the machines by gearing. Fig. 3 shows a group of three-head frame slotters thus driven; such tools as are operated at constant speed are belted to a line shaft driven by a belted motor.

In the boiler shop the large punches and shears are driven by individual compound-wound motors, which are belted to the tools. The slipping of the belt in starting, due to the unusually large inertia of this class of tools, allows the motor to start with much less current than would be required if the motors were geared, and the compounding of the fields has the same effect, as it increases the torque of the motor.

To the north of the machine shop lie the forge shop and the wheel shop. In the forge shop, motors are used where possible, but as nothing has been found thus far to displace steam hammers, the number of motors is not very large. In the wheel shop, the machine tools are all of a constant speed type and are belted to countershafting. The whole shop is driven by a Bullock 60-hp motor. To the north of the wheel shop lies the foundry, and electricity is used for all purposes to which it is applicable. The drop for breaking the scrap, the blowers for the cupolas, and the ventilating fans as well as the cranes, are all motor-driven. The distance from the power house to the foundry is so great that no other method of transmission could be considered.

Placed along the east side of the foundry is a traveling runway which passes along the side of the wheel shop, the end of the machine shop, and extends as far as the transfer table. The crane bridge is 40 ft. long, thus giving excellent yard service to the various shops and affording a very satisfactory method of transporting material from one department to another. In the wood shop the tools are operated at constant speed, and most of them are driven by belts from line shafts which are motor driven. The power house is located at the south of the group of buildings where the handling of fuel and ashes can be done most conveniently.

The generating and motor equipment was furnished by the Allis-Chalmers Co. and the switchboard by the Western Electric Co. Mr. Theo. E. Curtis, superintendent of machinery, designed the shops and supervised the installation of the machinery.

Turn-Down Incandescent Lamp.

The accompanying cut illustrates a new type of turn-down lamp recently placed on the market by the Rooney Electric Lamp

SUN-STAR TURN-DOWN LAMP.

Co., of New York. As shown, the lamp and the base, upon which the switching device is located, are separable. This construction allows the base to be removed from an old or broken lamp, by loosening the milled screw at the top. It can then be attached to a new lamp at a saving in price to the consumer, as it is practically indestructible. The switching device is made of hard copper, which prevents any arcing, and the entire base is finished in nickel. In the form shown, the switch is operated by two strings, at the ends of which are a black and white glass bead. By pulling on the black bead, the lamp is turned low, and

on the white bead, the full candle-power will be obtained.

The turn-down scheme of the lamp is extremely simple. The main filament is joined directly in series with the "baby" filament, the two being connected permanently across the terminals of the lamp. From the junction point between the two filaments is brought out an insulated tap which passes to the switch which serves to short-circuit the "baby" filament when it is desired to operate the lamp at its full brilliancy. The short-circuiting switch consists of a miniature nut which travels along a small bolt as it is turned by the strings. A defect at the switch could produce no result more disastrous than the continuous operation of the main filament, the "baby" filament being shunted out of circuit. These lamps are designed for all the standard voltages and candle powers.

Applications of Jenney Electric Motors.

The Jenney Electric Manufacturing Company, of Indianapolis, Ind., is turning out a complete electrically-operated coffee grinder (Fig. 1) which has certain desirable mechanical features. It is built to stand on the floor, instead of on the counter, as is the case with most mills, and being entirely self-contained, can be easily moved from place to place. One of the strongest features of this mill, however, is the advantage given by the belt drive over the gear drive frequently employed. As will be seen from Fig. 1, the motor is belted to the grinder and there is a spring tension idler pulley for maintaining the tension on the belt. This

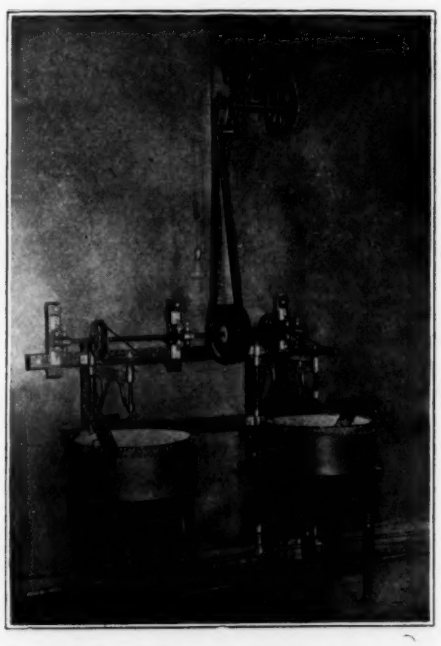


FIG. 1.—COFFEE MILL. FIG. 2.—APPLICATION OF BACK-BELTED MOTOR.

gives an elasticity and element of safety in the drive that frequently saves the mill from serious damage on account of nails or other foreign substances getting into the coffee.

The Jenney Company furnishes with some of its motors a useful attachment for obtaining very slow speed. This consists (Fig. 3) of a countershaft mounted on the motor frame to which the armature shaft is belted. An idler pulley with spring tension completes the combination. This placing of the countershaft on the motor frequently does away with expensive and unsightly countershafting which must be erected by a millwright, causing delay and extra expense in the installation. On the other hand, the belt is more noiseless than the gears frequently employed on back-geared motors. The idler overcomes most of the objections to the employment of a very short belt, as it maintains the proper tension and brings the belt in contact with a greater amount of the pulley surface. Fig. 2 shows an application of a back-belted motor to medicine mixers in the plant of the Eli Lilly Company, Indianapolis.

High Pressure Fire Pumping in New York City.

As a result of the recent ordinance authorizing the building of two new fresh and salt water pumping stations for the Borough of Manhattan, bids were recently closed and contracts awarded to the Allis-Chalmers Company, of Milwaukee, by the Commission of the Water Supply, Gas and Electricity. The equipment to be furnished consists of ten multi-stage, electrically-driven, centrifugal pumps, identical in design to those built by the Escher, Nyss Company, engineers of Zurich, Switzerland, and whose rights for this country are owned by the Allis-Chalmers Company. This equipment will be installed in two stations now in course of construction, one at the northeast corner of Gansevoort and West Streets, called the Gansevoort Station, and the other located at the northwest corner of Oliver and South Streets, called the Oliver Street Station. The two stations are identical in every way even to the arrangement of the interiors. These plants will be laid out to accommodate eight

FIG. 3.—BACK-BELTED MOTOR ON PEDESTAL.

pumping units, the piping being so arranged that when the three future pumps are installed it will only be necessary to remove the blank flanges from the toes to make the present arrangement of piping suitable for the operation of eight pumping units.

The pumps will be of the horizontal shaft, multi-stage, centrifugal type, connected to 800-hp induction motors. Each pump will be constructed with six runners: i. e., the water will be handled in six stages, each stage raising the total required amount of water through one-sixth of the total required head. The pumps are designed to give their maximum efficiency when delivering 3,000 gal. of sea water each per minute, at a speed of approximately 735 r.p.m., and delivering against a discharge pressure of 300 lbs. per square inch.

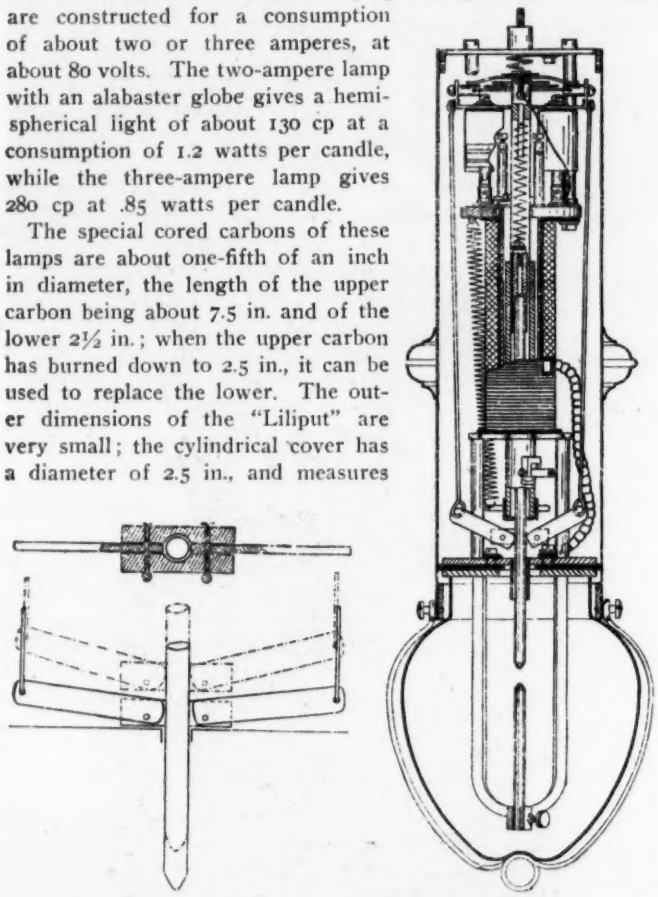
The induction motors are the type in which resistance can be inserted at starting to limit the current taken from the supply lines. These motors are built in accordance with the specifications of the Department of Water Supply, Gas and Electricity. It is expected that these stations will be in operation by the first of October.

"Liliput" and "Economy" Arc Lamps.

The "Liliput" arc lamps, which have recently been developed by the Siemens-Schuckert Company, are intended to occupy the field between the ordinary incandescent lamps and the more familiar forms of arc lamps. On account of their liliputian dimensions, economical burning and simplicity of handling they can be employed equally well for indoor as for outdoor purposes. They are built for either direct or alternating-current circuits.

The direct-current lamp has a restricted supply of air and is generally built for a single globe. For the regulation of the carbons it contains a movable clamping arrangement. The lamps are constructed for a consumption of about two or three amperes, at about 80 volts. The two-ampere lamp with an alabaster globe gives a hemispherical light of about 130 cp at a consumption of 1.2 watts per candle, while the three-ampere lamp gives 280 cp at .85 watts per candle.

The special cored carbons of these lamps are about one-fifth of an inch in diameter, the length of the upper carbon being about 7.5 in. and of the lower 2½ in.; when the upper carbon has burned down to 2.5 in., it can be used to replace the lower. The outer dimensions of the "Liliput" are very small; the cylindrical cover has a diameter of 2.5 in., and measures



FIGS. 1 AND 2.—REGULATING MECHANISM OF ALTERNATING-CURRENT LAMP.

12.3 in. in length, while the globe has a diameter of 3.25 in.

The alternating-current lamp is similar to the direct-current one with reference to its dimensions, but differs somewhat in mechanical construction. The construction and operation of the regulating mechanism are indicated in the accompanying illustrations. The upper carbon is moved in a vertical direction by means of two levers which are caused to clamp the carbon when a pull is exerted by the series-wound electromagnet upon the two wires shown. When the pull of the magnet becomes weakened the levers are allowed to drop against a plate which causes the levers to release the carbon, which then descends due to the action of gravity. Two dash-pots at the top of the mechanism serve to prevent too rapid movement of the regulating mechanism. When the upper carbon is lowered sufficiently the current through the arc increases and the electromagnet tends again to separate the carbons until the current reaches its normal value. The operation of the regulating mechanism is such that the illumination remains approximately constant, even when the carbon is being lowered.

The fittings of the "Liliput" lamp for alternating current are the same as those of the direct-current lamp, but since with the alternating-current arc a large part of the light is thrown to the upper hemisphere, a reflector must be used with this type of lamp. They are designed for a circuit e.m.f. of about 100 volts, about 70 volts of which are used at the arc, the remainder being used up in an impedance. Each lamp consumes about three amperes.

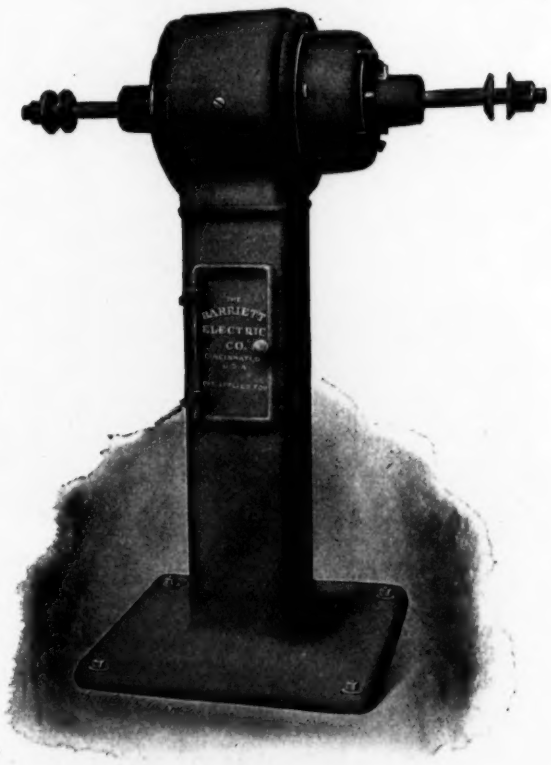
The Siemens-Schuckert Company has recently introduced another type of arc lamp known as the "Economy," which occupies a place between the "Liliput" lamp and the usual form of arc lamp. This lamp can be used on a 100-volt, direct-current circuit, or two of them may be connected in series on 200 or 220 volts. Each lamp operates at an active pressure of 80 volts, and according to its design consumes 3, 4 or 5 amperes, giving an average hemispherical illumination of 355, 500 or 760 cp, respectively. The upper carbon is 10.5 in. long, while the lower is 3.5 in. The two carbons burn in an almost air-tight space for about 25 hours at one trimming. The carbon consumption is stated to be about one-twentieth of that found with open arcs.

The mechanism is extremely simple and contains only a grip feeder. It permits the lamp to assume normal condition rapidly after the circuit is completed without undue hunting. It is expected that these lamps will prove successful competitors against the gas arc lamps. These lamps are being placed on the American market by Felix Hamburger, 90 William Street, New York.

Barriett Direct-Current Motors.

The Barriett Electric Manufacturing Company, Cincinnati, O., recently placed on the market two new types of direct-current motors of the semi-enclosed and fully-enclosed types, respectively. These motors are extremely simple and rigid in construction. Owing to the special design of the oil chambers they may be operated on the floor, wall or ceiling without the necessity of changing the end brackets.

The frame is of cast iron, and to it are bolted cast-steel pole pieces. The armature is of the standard slotted-drum type with form-wound coils. Two carbons are used in each brush holder



MOTOR-DRIVEN EMERY GRINDER.

so that carbons may be changed if necessary while the machine is running. These motors are designed for either constant-speed or variable-speed service.

In the accompanying illustration is shown a motor of the fully-enclosed type mounted for use with two emery wheels. As will be noted, the outfit is neat and compact. The motor differs from the standard enclosed motors only with respect to the bearings which are made somewhat longer; it is equipped with doors which permit inspection of the brushes and commutator.

The Wire and Telephone Company of America.

The Wire & Telephone Company of America in order better to meet the demand for its present products and also to enter extensively into the manufacture of telephone apparatus and supplies, has just completed a large addition to its plant at Rome, N. Y. The company was organized for the purpose of manufacturing bare copper wire, magnet wire, rubber-covered wire, telephone apparatus, telephone supplies, etc. Shortly after its incorporation the company acquired the Electric Wire Works and the Empire Wire Company, both of Rome, N. Y., and the machinery of the latter was moved to the site of the Electric Wire Works where better facilities were afforded and room for development and growth was available.

Since purchasing these plants the company has expended considerable money in improved machinery and equipment. The concentration of the two plants on one site necessitated an entire rearrangement and remodeling of the works, and additions were made to the old buildings whereby the floor space was increased by a third.

The building for the manufacture of insulated wire and telephone supplies is of brick and steel construction. The first section of this building is 270 ft. in length and 75 ft. in depth, and the addition of sections contemplated will so enlarge the building that ultimately it will have a depth of 600 ft. Across the front of the building is a two-story section, the upper story of which is used for offices, draughting rooms and engineering and developing work. The main building in general is a one-story structure with the excellent provisions for light and ventilation that is possible.

The manufacture of bare copper wire is now carried on and completed in the enlarged and remodeled wire mill buildings. The machinery is arranged so that from the copper rod to the finished wire the manufacturing processes are progressive. The rods are taken directly from the cars on a siding, weighed and stored. After leaving the storeroom the drawing, annealing, pickling and cleaning operations follow each other in rapid sequence. To guard against possible shut down the machinery is in duplicate.

The insulating departments are housed in the new building, and wire to be insulated passes direct from the mills to this building. The winding machinery is arranged so that additional units may be installed at any time without interfering in the least with the operation of the rest of the machinery. The wire is wound with single, double or triple cotton or with single or double silk covering.

The rubber insulating department is situated at one end of the building, where the heavy machinery required for this work is to be concentrated. This department is in charge of men having years of experience with the best manufacturers of rubber-covered wire, and the company has secured the services of two of the most expert rubber compounders in the country to supervise this branch of the work.

The general offices of the company are on the second floor of the new building, but the greater part of this floor is set aside for the development of a special form of telephone instrument and for the manufacture of a new type of binding post. The company controls the fundamental Houghton-Potter telephone patents, and telephone engineering and contracting departments have been established for the purpose of designing and installing telephone systems in factories, office buildings, apartment houses, hotels, towns, cities, etc. The company makes a careful study of local conditions in each case and prepares plans and specifications to insure the installation of a system best suited to the requirements, and upon it rests the entire responsibility of the installation.

The buildings are well lighted and the machinery is driven by induction motors, power being purchased from the Rome Gas, Electric Light & Power Company, the transmission line from Trenton Falls passing the works. A large brick and steel vault extending through to the second floor has been built in the new building for the purpose of keeping the large stock of diamond wire dies, special tools, silk, etc., carried by the company. A railroad siding from the New York Central tracks runs between the old and new buildings, and a track also runs along the front of the works for their entire length. Bare wire is shipped direct from the wire mills and insulated wire is shipped from both ends of the new building. The company manufactures copper wire from No. 0000 to No. 40, cotton and silk-covered magnet wire, rubber-covered wire, switchboard cord and cables, German silver wire, piano wire, etc. Only copper of 98 per cent conductivity is used and the product is subjected to rigid tests at every step. Every piece of magnet wire is tested by hand for imperfections and rewound on spools before shipment. The company owns a plot of ground 600 ft. deep in the rear of the works upon which it purposes to build in the spring. The rear wall of the new building is false and this will be moved back bodily 70 ft. so as to double the floor space of the insulating department.

The directorate of the company is as follows: J. S. Dyett, president; Oliver Shiras, vice-president; F. M. Potter, Jr., vice-president; H. T. Dyett, secretary-treasurer; T. H. Stryker, W. C. White, R. A. Downey, S. H. P. Pell and S. C. Houghton. Mr. Potter was formerly manager of the Syracuse Telephone Company. Mr. Shiras was connected with the board of managers of the British Westinghouse Company. Mr. Stryker is president of the First National Bank of Rome. Mr. White is vice-president of the White Sewing Machine Company, of Cleveland. Mr. Downey is president of the First National Bank of Oswego, and Mr. Pell is connected with the New York banking firm of S. H. Pell & Co. The company is managed by an executive committee consisting of Messrs. Shiras, J. S. Dyett, H. T. Dyett, F. M. Potter and S. C. Houghton, in whom is vested all power in the conduct of the business.

Current Indicator for Spark Coils.

In the operation of a gas engine, trouble is frequently experienced with the sparking equipment due to improper adjustment. A coil will cause the firing of a charge perfectly with a certain amount of current, and all in excess of this amount is more than a loss, as the greater the amount of current passing through the coil the more rapidly the battery becomes exhausted, and the sparking and timing contacts deteriorates, thus introducing unnecessary wear and improper timing. In adjusting the coil, increasing the tension on the vibrator increases the current passing through the coil, and in the majority of cases the coils are adjusted to consume more current than is actually required to do the work.

CURRENT INDICATOR FOR SPARK COIL.

The device shown in the accompanying illustration, which is intended to allow the sparking apparatus to be properly adjusted, has recently been placed upon the market by the Connecticut Telephone & Electric Company, Meriden, Conn. It consists of a special form of indicating meter, attached to which is a double conducting cord and metallic circuit plug. When the device is being used, the metallic circuit plug is substituted for the running plug, thus placing the instrument in circuit, so that it indicates the value of the current passing through the coil.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The present winter conditions have apparently had no effect upon spring trade in dry goods, clothing, etc., expansion being reported generally. Retail trade was appreciably benefited by the weather, but, it is stated, considerable stocks will be unquestionably carried over. Generally favorable conditions are reported in other lines. Collections are fair to good, except at the South, where the holding of cotton is a drawback. The market for iron and steel was weaker, the general tendency being for premiums to disappear. Structural material continues active, though new business in the East is not so heavy. A despatch from Pittsburg states that orders have accumulated so rapidly on the books of the United States Steel Corporation that it has been found necessary to decline new business, representing thousands of tons, because it could not agree to make deliveries at a specified time. The orders now on the books are nearly 8,000,000 tons, which is within 2,000,000 tons of the entire capacity, and the corporation has found it necessary to close its order books to certain classes of material. Steel rails and plates are in good demand, railways having placed additional orders for track material. The machinery trade is in good conditions, and much new business is pending. Copper is steady in price with a waiting market. The majority of the greater domestic producers are quoting Lake and electrolytic at 18¼ and 18½c. for future delivery. Casting copper is in fair demand, but the stocks are inadequate. For round lots for May delivery it is quoted at 18@18¼c. January exports of domestic products make the best showing ever recorded in that month. Breadstuffs, especially corn, show large increases over a year ago, as do also cotton, provisions and oils. Exports of five leading products exceed January a year ago by 47 per cent, though 22 per cent less than in December. Seven months' exports of these products likewise break all records. *Bradstreet's* reports 208 business failures during the week ending Feb. 15 against 204 the previous week and 243 in the corresponding week last year.

A LARGE COPPER PLANT.—The Nevada Consolidated Copper Company, San Francisco, whose properties are located near Ely, Nevada, where a new 1,000-ton concentrating, roasting and smelting plant is in process of construction, has recently let the contracts for the entire equipment, including power and electrical apparatus, to the Allis-Chalmers Company, of Milwaukee. The main shafting for the entire group of six furnaces will be driven from a 20-hp Bullock induction motor, running at a speed of 850 r.p.m.. The operator will be enabled to control the operation of each furnace from any one of three floors or stages about them. The engine equipment consists of two 22 and 48 x 48-inch compound condensing, heavy duty type; a blowing engine with cylinders 16 x 32-in., to deliver 6,000 cubic feet of free air per minute, and electrical machinery as follows: two 800-kw Allis-Chalmers Bullock engine type alternators, two exciters and seven motors, ranging from 20 to 100 hp, for the operation of the various ore reducing devices, furnaces, etc.

AIR-BRAKE EQUIPMENT FOR PITTSBURG RAILWAY.—The Pittsburg Railway Company will install 20 emergency straight air-brake equipments for motor cars and 10 emergency straight air-brake equipments for trail cars, furnished by the General Electric Company, of Schenectady, N. Y. The cars upon which these equipments will be mounted are to be run singly and in two-car trains, consisting of one motor car and one trailer. The type of air-brake equipment above mentioned, sometimes called "semi-automatic," is essentially a straight air-brake system, having in addition an emergency valve on each car, which in case the train breaks apart, disconnects the brake cylinder from the train line and connects it directly to the main reservoir, thus applying the brakes on all cars, just as in the automatic system. In ordinary service, the operation is exactly the same as with a standard straight air-brake system. This method therefore combines the simplicity, reliability and easy manipulation of the straight air-brake system with the emergency protection of the "automatic" system.

THE ABNER DOBLE COMPANY, of San Francisco, has recently taken a contract for a Doble tangential water wheel unit which will have a capacity of 13,000 horse-power, thus surpassing in power any tangential wheel now built or contracted for. The unit has been ordered by the California Gas & Electric Corporation, for installation in its noted Colgate plant, where it will form a valuable addition to that company's extensive hydro-electric system. It will be of the double-wheel two-bearing type of construction, and when first installed will operate under an effective head of 660 feet, delivering 8,500 horse-power. It is planned eventually to increase the pressure on one of the wheels by delivering the water through a new pipe line under an effective head of 1,050 feet. This will bring the output of the unit up to 13,000 horse-power. The unit will operate at a speed of 300 r.p.m. and will drive a 5,500-kw Westinghouse generator. It will be equipped with a Bethlehem nickel-steel hollow forged shaft, and Doble ring-oiling revolvable-shell bearings, needle regulating and deflecting nozzles, ellipsoidal buckets, and centrifugal water guards.

LARGE POWER HOUSE ECONOMIZERS.—In the new power house of the Interborough Rapid Transit Co., New York City, the 26,000-hp of boilers now installed are soon to be equipped with economizers built by the B. F. Sturtevant Co., of Boston, Mass. The 28 economizers will contain 7,840 pipes, having an aggregate length of nearly 15 miles. They will increase the heating surface of the plant about 25 per cent and store 265 tons of hot water or 18 per cent of the volumetric capacity of the boilers. It is estimated that the saving due to the utilization of heat in the waste gases will average more than 10 per cent for the whole 24 hours. This figure will be greatly exceeded while the load is at a maximum, at which time the heat will be utilized which was previously stored while the fires were banked.

STURTEVANT ORDERS.—Among recent orders for generating sets received by the B. F. Sturtevant Company, of Boston, Mass., may be mentioned those for the Garlock Packing Company, Palmyra, N. Y.; New York State Reformatory for Women, Bedford, N. Y.; Union Drop Forge Co., Chicago, Ill.; Tennessee Bag Company, Memphis, Tenn., and the Wildman Mfg. Company, Norristown, Pa. The Thomas Devlin Mfg. Co., Burlington, N. J., is installing a complete system of Sturtevant electric propeller fans for exhausting smoke from its foundry building. Marine generating sets are to be furnished for the turbine steamer "Governor Cobb," of the Eastern S. S. Co., Boston, Mass., and the police boat, "Samuel G. King," Philadelphia, Pa.

HEAVY JANUARY TRADE is noted by the government, in exports and imports. In fact the month's foreign trade was the largest on record for any January. The increase in merchandise exports over a year ago was $47,036,779 and in imports $8,218,574. In other words the merchandise exports were $170,634,162 and the imports were $106,561,450, showing an export excess of $64,072,712; while the total exports for the seven months are already $1,056,656,764. Another striking fact is that out of the month's export of $170,000,000 over $74,000,000 were non-agricultural.

NEW TELEPHONE EXCHANGE.—Plans have been filed with Building Superintendent Murphy for a new 3-story and basement structure to be built for the New York Telephone Company at the northwest corner of Convent Avenue and 146th Street. It is to be of colonial design, with facades of ornamental brick with terra cotta trimmings, is to be called the Audubon central station and is to cost $110,000.

PENNSYLVANIA POWER PLANT.—The Pennsylvania Railroad Company has filed plans with the building department for an electrical power station on the south side of 31st Street, facing the new terminal. The building is to be 99x161 ft. and four stories high, in the same architectural style as the terminal. The estimated cost is $300,000.

THE SPRAGUE ELECTRIC COMPANY has recently sold 16 motors to Edwards, Deutsch & Heitmann, Chicago, for driving printing presses and allied machines. Among other well-known firms that have placed orders with the Sprague Company are Styles & Cash, New York City, 37 motors; G. Schirmer, music publisher, New York City, 25 motors, and Perley & Company, Pittsburg, 22 motors.

ELECTRICAL EQUIPMENT FOR WORSTED MILL.—The General Electric Company has secured the contract for installing the electrical equipment in one of the largest and best equipped factories for the manufacture of worsted yarn in the world, now in course of construction at South Lawrence, Mass., for the Wood Worsted Company. In the power house will be located two main generating units, consisting of a double non-condensing 1,800-hp engine, direct-connected to a 1,500-kw generator and a compound condensing engine with two vertical and two horizontal cylinders, of 5,000-hp capacity, direct-connected to a 4,000-kw generator. There will also be a 100-kw generator for light loads and emergency work; besides a 65-kw, 125-volt motor-driven exciter generator and a small direct-connected steam unit of the same capacity as a reverse. The generating units will supply current at 40 cycles and 680 volts to a complete and modern switchboard, from which distribution will be made to the various buildings. The switchboard will consist of 33 panels. About 500 hp of induction motors will be required for driving the various groups of machinery. The motors are of the latest G. E. type, wound for 550 volts and range in size from 8 to 175 hp. The general lighting will be done by 200 direct-current arc lamps, the transformation from alternating to direct current being accomplished by means of constant-current transformers and mercury arc rectifiers. Six 25-kw and 10-kw transformers will furnish current for the incandescent lamps.

ALLIS-CHALMERS CONTRACTS.—The Dempsey Lumber Co., of Manistee, Mich., which will furnish its new Tacoma, Wash., mill with one of the largest and most complete outfits ever installed in that section, will use Allis-Chalmers engines, generators and electric motors for power, lighting and machine-drive. The Sutton Lumber & Trading Co., which has started the erection of a large mill at Clayoquot Sound, on the west coast of Vancouver Island—the first in that section—will install a Reynolds-Corliss twin engine and complete electric lighting and power plant, in addition to the full equipment of saw mill machinery purchased from Allis-Chalmers Company. The Ancortes Lumber & Box Company, Ancortes, Wash., has added to the full line of saw-mill machinery recently supplied by Allis-Chalmers Company a Bullock generator for direct connection to its engine. The Foster Lumber Company, Clinesburg, Texas, will install a Bullock generator for furnishing electric current with which to drive its saw mill and elevating machinery. The Pratt Mill & Elevator Company, of Pratt, Kan., and the Kramer Milling Company, of Wellington, Kan., have ordered Allis-Chalmers power equipments for their new mills, which are to be furnished throughout with machinery made by the same company, and new mills to be constructed in the Canadian Northwest have ordered, through Allis-Chalmers-Bullock, Ltd., of Montreal, motors aggregating 5,250 hp to be furnished at once.

FACTORY POWER PLANTS.—Some of the recent factory plants installed by the Triumph Electric Company, of Cincinnati, are a 200-kw generator, switchboard and 30 motors for the Yellow poplar Lumber Company, Coal Grove, Ohio; a 150-kw, direct-connected generator, switchboard and motors for Helmers, Bettman & Co., shoe manufacturers; a 150-kw belted generator, switchboard and motors for the John Van Range Company.; 56 motors for the A. H. Pugh Printing Company, and 25 motors for the U. S. Printing Company, which had previously purchased a Triumph generator and a quantity of Triumph motors. All of these plants are equipped according to the latest engineering practice, the machinery being operated either by group or individual motor drive.

ELECTRICALLY DRIVEN PUMPS.—The City of New York, Borough of Manhattan, has ordered ten electrically-driven, multi-stage centrifugal pumps, each having a capacity of 3,000 gallons per minute against a head of 300 pounds per square inch, together with all the station appurtenances for high-pressure service from the Allis-Chalmers Company, Milwaukee, Wis. The Delaware, Lackawanna & Western Railroad Company has also ordered from the Allis-Chalmers Company four centrifugal electrically-operated pumps, three each having a capacity of 250 gallons per minute against a head of 100 feet, and one having a capacity of 700 gallons per minute against a head of 100 feet for mine service in the Lackawanna County, Pa., coal region.

THE ELECTRIC CABLE COMPANY, of 42 Broadway, New York, has just received an order from the New York & Long Island Railroad Company for 15 miles of cables insulated with Voltax, the new high potential insulating compound. This order follows with a week that of the Interborough Rapid Transit Company, who recently ordered from the same company the same amount of material.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was quiet with a heavy tone, and declines of a moderate character were general throughout the list. The anthracite coal labor situation and higher money rates exercised a restrictive influence. The Steel stocks attracted no particular attention despite the reports of a deal between the corporation and the Great Northern concerning the latter's ore lands, and the continuance of the good reports about the steel industry. Allis-Chalmers closed at 22⅜ for common and 62 for preferred, these quotations representing net declines of 1⅝ and 1⅛ respectively. General Electric closed with a net loss of 5 points at 170, and Westinghouse dropped 4⅝ points, the last quotation being 161. Westinghouse rights are quoted at ⅛. American Locomotive common closed at 71⅞, a loss of 3⅞, and preferred at 116, a loss of ½ point. Brooklyn Rapid Transit fluctuated between 86¼ and 78½, but regained some of the loss and closed at 79⅝, which is a net decline of 5⅜ points. Metropolitan Street Railway closed at the lowest quotation of the week—116¾, being a decline of 3½ points. The final quotation of Interborough Rapid Transit was 227½, a loss of 5¼ points. Interborough-Metropolitan common is quoted on the curb at 53½ and 4½s at 93¼. Mackay Companies reached 62, but declined to 58⅜, which was the closing price and a net decline of 3 points. Western Union Telegraph closed at 93 and American Telephone & Telegraph at 141½, the former being a net loss of ¼ and the latter 1 point. Following are the closing quotations on Feb. 26:

NEW YORK

	Feb. 13	Feb. 20		Feb. 13	Feb. 20
Allis-Chalmers Co.	23⅜	22¾	General Electric	174½	171½
Allis-Chalmers Co. pfd.	63	61⅜	Hudson River Tel.	...	...
American Dist. Tel.	37	37	Interborough Rap. Tran.	232	228¼
American Locomotive	75	72⅛	Mackay Cos.	61⅛	59
American Locomotive pfd.	116⅛	116⅛	Mackay Cos. pfd.	74	74
American Tel. & Cable	91	80	Marconi Tel.	...	...
American Tel. & Tel.	141¾	140½	Metropolitan St. Ry.	120¾	117¾
Brooklyn Rapid Transit	85⅛	81	N. Y. & N. J. Tel.	...	...
Electric Boat	25	25	Western Union Tel.	93	93⅛
Electric Boat pfd.	60	60	Westinghouse com.	165	161½
Electric Vehicle	16	17	Westinghouse pfd.	...	...
Electric Vehicle pfd.	19	19			

BOSTON

	Feb. 13	Feb. 20		Feb. 13	Feb. 20
American Tel. & Tel.	142¼	140¾	Mass. Elec. Ry. pfd.	69	68
Cumberland Telephone	117⅜	117¾	Mexican Telephone	4	...
Edison Elec. Illum.	...	...	New England Telephone	...	...
General Electric	...	...	Western Tel. & Tel.	...	...
Mass. Elec. Ry.	20	20	Western Tel. & Tel. pfd.	...	93

PHILADELPHIA

	Feb. 13	Feb. 20		Feb. 13	Feb. 2
American Railways	53	...	Phila. Electric	8	...
Elec. Co. of America	11⅜	...	Phila. Rapid Trans.	32¾	...
Elec. Storage Battery	80	...	Phila. Traction	...	...
Elec. Storage Battery pfd.	...	...			

CHICAGO

	Feb. 13	Feb. 20		Feb 13	Feb. 20
Chicago City Ry.	185	190	National Carbon	83¼	86
Chicago Edison	...	...	National Carbon pfd.	120	117
Chicago Subway	...	...	Union Traction	...	...
Chicago Tel. Co	...	...	Union Traction pfd.	...	...
Metropolitan Elev. com.	26¼	29			

* Asked.

N. Y. & N. J. TELEPHONE.—President Bethell has presented his annual report to the stockholders of the New York & New Jersey Telephone Company. The income account of the company for the year ended Dec. 31, 1905, compares as follows:

	1905.	1904.	1903.	1902.
Gross	$6,217,288	$5,393,709	$4,741,344	$3,962,597
Expenses	4,575,845	3,729,335	3,269,996	2,823,458
Net	$1,641,443	$1,664,374	$1,471,348	$1,139,139
Charges and taxes	195,428	187,422	181,214	166,350
Surplus	$1,446,015	$1,476,952	$1,290,134	$972,789
Dividends	1,034,149	962,089	852,216	707,627
Surplus	$411,866	$514,863	$437,918	$265,162

The reduction in rates in Brooklyn, Queens and Richmond, Jersey City, Newark and other places during the year rendered the surplus smaller proportionally than in previous years. The gain in stations during the year was 31,725, or nearly 40 per cent. The authorized capital stock of the company is now $17,360,000, an increase of 25 per cent during 1905. Expenditures for construction last year amounted to $3,027,000. Total number of stations on Jan. 1 was 112,049.

NORTH AMERICAN STOCK.—The additional $73,700 capital stock of the North American Company, which has been listed on the New York Stock Exchange, is to be used for the purpose of acquiring 737 additional shares of par value of $100 each, of the capital stock of the Union Electric Light & Power Company; the remaining authorized capital stock of the North American Company, $226,300, is to be issued to purchase capital stock of the Union Electric Light & Power Company and the common stock of the Laclede Gas Light Company.

THE MACKAY COMPANIES published its annual report last week showing the steady growth of this great telegraphic corporation. During the year the preferred stock was increased by $4,676,900, which was issued in exchange for stock in other corporations. Among the securities acquired was stock representing a controlling interest in the North American Telegraph Company, which operates in Minnesota, Wisconsin, Iowa and Illinois. The Mackay Companies, besides controlling the Commercial Cable Company and the Postal Telegraph lines, is one of the largest stockholders in the American Telephone & Telegraph Company. In regard to the dividend policy of the company the trustees in their report to the stockholders say: "The income of the subordinate companies of the Mackay Companies is largely in excess of the amount required to pay these dividends, but its policy is to obtain from its subordinate companies only enough money to meet the dividends on the Mackay Companies shares. All surplus earnings are left in the treasuries of the subordinate companies for extensions and the development of the business and the increase of reserves." Dealing with the Commercial Cable Company the report refers to the new Pacific cables, and says that the lines to Japan from Guam and to China from Manila will be put in operation by April 1. The report shows that the income from subsidiary companies during the period from February 23, 1905, to February 1, 1906, was $2,719,595. The Mackay Companies distributed $2,332,492 in dividends, paid out $23,186 for various expenses, and carried forward $363,917. The issued capital stock consists of $40,645,600 preferred and $41,380,400 common.

BALTIMORE UNITED BONDS.—The United Electric Light & Power Company of Baltimore, Md., is offering $1,000,000 first consolidated mortgage 4½ per cent bonds—an underlying bond of the Consolidated Gas, Electric Light & Power Company of that city, through N. W. Harris & Co. The business of the company shows earnings of 8.6 per cent on $2,000,000 common stock, over and above bond interest and preferred dividends. The total bonds authorized are $4,500,000. The United Electric Light & Power Company was on Feb. 14, 1905, merged into the Consolidated Gas, Electric Light & Power Company of Baltimore. This latter company, in addition to its large electric lighting and power interests, owns $6,563,400 par value, out of $10,770,968 outstanding capital stock of the Consolidated Gas Company of Baltimore, thereby controlling the entire gas business of the city. This Consolidated Gas Company stock is deposited with trustees as additional collateral security under the mortgage securing the general mortgage bonds of the Consolidated Gas. Electric Light & Power Company. The above bonds, in addition to being an underlying security of the Consolidated Gas, Electric Light & Power Company ($12,700,000 outstanding capital stock and $7,288,000 outstanding general mortgage bonds), are secured, in opinion of counsel, by a first mortgage on the entire property, including franchises unlimited in time of the former United Electric Light & Power Company, subject only to $257,000 underlying bonds.

NATIONAL ELECTRIC OFFER.—The Standard Trust Company of New York has made an offer of 30 per cent of the face value of all proved and undisputed claims against the bankrupt National Electric Company of Milwaukee. Bloodgood, Kemper & Bloodgood, representing a majority of the creditors of the bankrupt concern, have sent a letter to clients advising the acceptance of the offer. It is said that creditors having claims of more than $400,000 have already signified their willingness to accept it. While the exact amount of the offer is undeterminable, it is said that it is equal to $750,000 if all disputed claims are thrown out, and is equal to more than $850,000 if all disputed claims are sustained. The offer of the Standard Trust Company is made only to those creditors having undisputed claims against the estate, and it is expressly stated that the offer will not hold good if a majority of the creditors do not accept within two weeks from the date of the letter, February 17. The National Electric Company went into bankruptcy following the defalcation of Frank G. Bigelow, formerly president of the First National Bank of this city. Bigelow was one of the chief promoters of the concern. Mr. John I. Beggs, as receiver, then took hold and by hard and intelligent work brought the affairs of the concern into a condition where it again had a large value.

POWER DEAL IN VERMONT.—The consolidation and merger of the Rutland (Vt.) Street Railway Company, the Crittenden Power Company, the People's Gas Light Company and the Vermont Internal Improvement Company has been completed. The Vermont Improvement Company was chartered by the Legislature of 1902 with a capital stock of $100,000, for the purpose of acquiring electric railways and lighting and heating plants anywhere in the State of Vermont and to establish an electric trunk through Rutland County and southern Vermont. The combined capital of the consolidated companies was $2,400,000. The officers of the company are: President, G. T. Rogers, Binghamton, N. Y.; vice-president, L. H. Wise, of New York City; secretary and treasurer, C. H. West, Rutland, and these gentlemen with J. H. Powers, of Troy, N. Y., and George T. Chaffee, of Rutland, constitute the board of directors. The property will be known under the name of the Rutland Railway, Light & Power Company. Messrs. Rogers and Powers are well known in the lighting and traction field of the Empire State.

NEBRASKA TELEPHONE STOCK.—The Nebraska Telephone Company, a sub-company of the American Telephone & Telegraph Company, is offering 10,000 shares of new stock to stockholders at par in the ratio of one share of new stock for every three shares held as of Feb. 15, 1906. The stock will be paid for in four instalments ending Sept. 30, 1906. The new issue is made necesary by the rapidly expanding business and is the first substantial increase since 1893. The outstanding stock at present is $2,635,000 and there is no bonded debt. The proceeds from the sale of the new stock will be used to pay off floating indebtedness incurred to meet the rapidly growing business. The company had on Dec. 31, 1905, a total of 35,855 stations, an increase of 8,501 during the year, equal to a gain of 31 per cent. It also has had 21,593 sub-license stations and 18,713 miles of toll line wire. During the year $420,000 was charged off to maintenance, as was the case in 1904 and 1903. Expenditures for new construction amounted to $957,171. The total income for 1905 was $1,361,456.

SAN FRANCISCO GAS & ELECTRIC COMPANY has made the following report to the Supervisors: Revenues—From sales of gas, $2,528,905.81; from sales of electric current, $2,055,923.48; from all other sources, $72,639.19; total, $4,657,469.19. Cost—Gas, $2,039,122.72; electric current, $1,638,667.41; total, $3,677,790.13; net profits, $979,678.06; dividends paid, $792,421.68; surplus for the year, $187,256.38. Original cost of plant—Gas, $16,803,639.88; electric, $6,535,216.85; total, $23,338,856.73. Present cost of plant—Gas, plant, $9,345,038.65; pipes, $7,196,633.94; meters, $904,717.58; lamps, $81,114,88; total, $17,527,505.05; electric, plant, $6,562,957.17; conduits, $2,018,197.96; meters, $233,445.61; total, $8,814,600.74; present value of plant, $26,342,105.79; capital stock outstanding, $15,794,284.36; amount of bonds outstanding, $9,813,813; amount of floating debt, $237,400.28.

UNITED GAS IMPROVEMENT.—The United Gas Improvement Company, of Philadelphia, will increase its capital stock by $9,181,250, making the total $45,906,250, the new stock being offered to stockholders at par. The chief purpose of the increase is to purchase a third interest in the Public Service Corporation of New Jersey, control of which will be shared with the Prudential Life Insurance Company interests and the Pennsylvania Railroad. The Public Service Corporation is to issue $12,500,000 treasury stock.

NORTH AMERICAN STOCK INCREASE.—The North American Company has applied to list $300,000 additional capital stock. Of the increase of $15,000,000 authorized by the stockholders a year ago $14,700,000 were listed. Of the amount all but $60,000 was issued. It is now proposed to issue the $60,000 and the balance of the increase, a total of 3,600 shares. The stock will be used to acquire some of the outstanding stock in one of the subsidiary companies.

ROCKY MOUNTAIN BELL.—The annual meeting of the stockholders of the Rocky Mountain Bell Telephone Company will be held in Salt Lake City on February 26. A special meeting of the stockholders will also be held on the same day for the purpose of voting on an increase in the capital stock of the company to $10,000,000. The present outstanding capital stock is $2,304,800.

BELL TELEPHONE BONDS.—Applications for participation in the American Telephone & Telegraph Company's $100,000 issue of 4 per cent convertible bonds are said to have been more than could be accommodated. Allotments were made as follows: Twenty per cent to Europe, 30 per cent to New England, and the remainder to New York and the country at large.

DIVIDENDS.—The directors of the American Telegraph & Cable Company have declared the regular quarterly dividend of 1¼ per cent, payable March 1. The directors of the Manila Electric Railroad & Lighting Corporation have declared a dividend of 1 per cent on the capital stock of the company, payable April 2.

GENERAL NEWS.

Construction Notes.

MONTGOMERY, ALA.—The Montgomery Light & Water Power Company is contemplatinng the installation of a storage battery outfit.

ALBERTVILLE, ALA.—The Mayor and Board of Aldermen have accepted the proposition of Prof. Edward Kay, of the State University, to install water works and an electric light plant.

BIRMINGHAM, ALA.—Ford, Bacon & Davis, 24 Broad Street, New York, N. Y., are the engineers for the proposed improvements contemplated by the Birmingham Railway, Light & Power Company. J. A. Emery, Birmingham, General Manager.

MOBILE, ALA.—In the condemnation proceedings of the Home Telephone Company against R. Moore, for right of way through certain property on Blakely Island, a decision favorable to the telephone company was had in the Probate Court. A commission is to be named to assess the damages. This decision will enable construction work to be begun.

SILOAM SPRINGS, ARK.—The City Council is considering the advisability of leasing its electric light and water works plants to a private individual for a term of years.

FORREST CITY, ARK.—The Forrest City Electric Company contemplates installing a new generator and boilers in its lighting plant. J. W. McCarty is manager and superintendent.

ESCONDIDO, CAL.—Hugh T. Duff, of Los Angeles, has petitioned the Board of Trustees for a franchise for an electric power plant.

VACAVILLE, CAL.—The Vacaville Water & Light Company is contemplating the construction of 8 miles of line during the summer. W. Z. McBride is manager.

ONTARIO, CAL.—The directors of the San Antonio Water Company have decided to install at a cost of $30,000 a steam or other power plant. This is intended to supplement the present water power.

OAKLAND, CAL.—It is reported that in the near future the San Francisco, Oakland & San Jose Railway (Key Route) will be extended up the bay shore from Berkeley, not only to Port Richmond, but also to Martinez.

LOS ANGELES, CAL.—The Los Angeles-Pacific Company has recently awarded a contract to Hunt, Mirk & Co., of San Francisco, to furnish a 2750-kw, three-phase, 50-cycle Westinghouse-Parsons turbo-generator. The contract also included a condenser with 9000 sq. ft. of surface, together with other auxiliary apparatus.

SAN FRANCISCO, CAL.—The Battle Creek Power Company has mortgaged its property to the Mercantile Trust Company, which has guaranteed its recent $1,000,000 bonds issue. The mortgage covers the capital stock, real estate, water rights and franchises of the power company. The bonds bear 6 per cent interest and are to run 30 years, being issued to provide for future expansion and improvements.

SANTA CRUZ, CAL.—Extensive improvements are contemplated by the Big Creek Power Company in the near future, which include the addition of considerable equipment, consisting of one 1,000-hp engine, direct-connected to one 780-kw, three-phase, 11,000-volt Westinghouse generator, one 450-kw, two-phase, 1,100-volt generator, direct-connected to a Pelton water wheel, two 180-kw, two-phase, 1,100-volt generators direct-connected to a Pelton wheel operating under 900 ft. head; 800 kw in transformers, 75 hp in small motors for operation on 200 and 400-volt circuits, and four 75-hp motors to furnish power to the Union Traction Company. C. E. Lilly is manager.

SAN FRANCISCO, CAL.—The Westinghouse Electric & Manufacturing Company has been given the contract to supply the Fort Bragg Electric Power Company, which is controlled by the Union Lumber Company, of San Francisco, an additional 300-kw engine-type alternator and a direct-connected engine. The new machines will be installed in the power plant at Fort Bragg. The plant will be enlarged to accommodate the new equipment, which is being provided to increase the capacity of the plant and enable the company to furnish electric current for lighting at Mendocino, ten miles distant down the coast. This has been contracted for by the Mendocino Electric Light & Power Company, and the necessary extension of the Fort Bragg line will be made at once.

SAN FRANCISCO, CAL.—What will be probably the northernmost hydro-electric plant in the world will be installed by the Yukon Consolidated Goldfields Company in the Yukon Territory, close to the Arctic Circle. The contract, which has been given to the Westinghouse Electric & Manufacturing Company, calls for a complete electric power transmission and gold dredging equipment and includes two 625-kw, three-phase, 60-cycle, 2,200-volt generators, which will be direct-connected to two Pelton impulse wheels; also three dredge outfits, each aggregating 250 hp in motors ranging from 100 hp down. There will be four Westinghouse 250-kw transformers at the power house and four 200-kw transformers at the sub-station. Power will be transmitted 30 miles at 30,000 volts for dredging purposes only. The electrical equipment will be shipped within the next five months via Hamilton, Ont., and Vancouver. O. B. Perry, whose headquarters are with the Western Engineering & Construction Company, Rialto Building, San Francisco, Cal., is manager of the Yukon Consolidated Goldfields Company.

DURANGO, COL.—The Animas Power & Water Company expects to add this year two 2,250-kw machines and several miles of transmission line. H. T. Henderson, general superintendent.

SILVERTON, COL.—A new switchboard will probably be installed in the municipal lighting plant and the system changed to three-phase alternating current. H. S. Sherman is city electrician.

BUENA VISTA, COL.—W. P. Eyre, lessee of the Buena Vista Electric light and power plant, owned by the Buena Vista Smelting & Refining Company, is contemplating improving the water power and will replace the present Heisler system with an alternating-current multiple system of incandescent lighting.

LITCHFIELD, CONN.—The Litchfield Electric Light & Power Company is making arrangements to extend its lighting and power circuits to Morris and Bethlehem, Conn. Guion Thompson is superintendent.

NEW HAVEN, CONN.—The Strouse-Adler Company proposes generating its own electricity and will put in a plant of sufficient capacity to supply 3,000 lamps and furnish about 100 hp for the operation of motors.

NORWICH, CONN.—The officials of the Norwich & Westerly Railway Company have placed the contract for the boiler and engines for the power house of the road. The engines will be 1500 hp and the boiler 1600 hp. Besides the main power house, there will be a sub-station in North Stonington. The location of the power house and the transformer station has not been definitely settled as yet.

WASHINGTON, D. C.—The Potomac Electric Power Company, of Washington, has contracted with J. G. White & Co., of New York, for the erection and equipment of a new power house for both lighting and power purposes in the city of Washington. This company is one of the sub-companies of the Washington Railway & Electric Company which divides with the Capital Traction Company the control of the electric traction business of the Capital City. The power house will cost in all about $1,500,000. The building is to be approximately 166x183x67 ft., and will have a steel frame with curtain walls, which will probably be constructed of moulded concrete blocks. The boiler room will contain four rows of boilers with three chimneys, located between the second and third rows. Thus, there will be two divisions of the firing floor, each serving two rows of boilers. The first installation will consist of two 2,000-kw and one 5,000-kw Curtis turbines with boilers and superheaters, and the building is designed for future installation of two additional 5,000-kw Curtis turbines with their steam generators, making a power house of 19,000-kw ultimate capacity. All of the turbines will generate 25-cycle, three-phase current at 6,600 volts for distribution directly to the sub-stations. Two of the 2,000-kw units are already installed, one of them being equipped with an ordinary type of surface condenser. All of the remaining units, however, will have the latest type condensers, self-contained in the base of the turbine. A storage battery will be installed, having capacity enough to furnish excitation current for the entire station for one hour.

PUNTA GORDA, FLA.—This city is considering issuing $18,000 bonds for constructing an electric light plant and water works system.

DALLAS, GA.—The citizens have voted $20,000 bonds for lights, water and schools.

JACKSON, GA.—The citizens have voted to issue bonds for water works and an electric light plant.

ADEL, GA.—The Adel Electric Light & Power Company has been organized with William Scandrett president. The preliminary work will be started at once and it is hoped to have the town lighted within a few months.

BLACKFOOT, IDAHO.—The Blackfoot Light & Water Company, which is controlled by the American Falls Power, Light & Water Company, of Pocatello, Idaho, is making arrangements for the reconstruction of the sub-station which was recently destroyed by fire. Power is purchased from the Pocatello Company. F. U. Bliss, of Pocatello, is general superintendent.

COFFEEN, ILL.—The Town Council has granted Frank C. Edwards a franchise for an electric light plant.

FREEPORT, ILL.—The contract for lighting the streets of Freeport for a term of five years from April 6, 1906, has been awarded to the Freeport Railway, Light & Power Company.

FISHER, ILL.—The Wardlow Electric Lighting Company is contemplating installing water works and a heating plant. A. L. Wardlow is manager and superintendent.

ROCK ISLAND, ILL.—The Central Union Telephone Company has proposed an ordinance to the City Council providing for the laying underground of all of its wires, except those used for distribution within the district known as the fire limits. This change means an expenditure of many thousands of dollars.

MOWEAQUA, ILL.—The Moweaqua Electric Company states that its plant is for sale. The town has a population of 1,478, and the lighting contract comprises twenty 2,000-cp arc lamps at $75 per lamp per year, operated on a moonlight schedule. The plant also supplies eight commercial arcs of 2,000 cp and furnishes electricity for about 3,000 incandescent lamps. W. F. Covington is manager and superintendent of the plant.

EAST ST. LOUIS, ILL.—At a meeting of the stockholders in St. Louis, Mo., on February 14, the Illinois Illuminating Company, which holds a franchise in East St. Louis to supply current for lighting and power, was practically reorganized and new officers elected. R. V. Scudder was chosen president; H. H. Humphrey, vice-president; Charles Scudder, Jr., secretary and treasurer. The company has purchased a lot 100 x 140 ft., on which will be erected a $100,000 plant, the construction work to begin immediately. All the machinery, boilers and equipment have been contracted for and will be installed as fast as the building is ready for them.

HENDERSON, IND.—The local telephone company is contemplating a number of improvements in its system here.

SOUTH BEND, IND.—Plans have been completed for a new $200,000 Y. M. C. A. building in this city which call for an unusual amount of electrical equipment for a building of the kind.

ATTICA, IND.—The City Council has granted a franchise to the Crawfordsville & Northwestern Interurban Railway to enter this city with a trolley line to be constructed from this place to Crawfordsville.

GOODLAND, IND.—The Board of Trustees expects to put in a new lead to the center of distribution and will overhaul the entire system of the municipal lighting plant. John Carpenter, Town Clerk, is purchasing agent.

BLOOMFIELD, IND.—The Home Light & Water Company is making arrangements to install a 150-kw generator and a 250-volt dynamo for the purpose of supplying a power circuit to be established shortly. Robert B. Dugger is manager of the plant.

KOKOMO, IND.—George J. Marott, president, and T. C. McReynolds, general manager, of the Kokomo Electric Light & Interurban Company, announce that they will enlarge and greatly increase the capacity of the plant and install some modern machinery.

CONNERSVILLE, IND.—The Central Manufacturing Company of this city has just completed the installation of its new building and is now ready for operation. The new building is a one-story structure, 540 feet long and equipped with modern machinery, driven by electric power. Seventeen electric motors, ranging from 3 to 30 hp and aggregating 195 hp have been installed. The officials say three additional motors will be installed in the spring.

CRAWFORDSVILLE, IND.—W. H. Smith, a wealthy farmer east of this city, is the first to experiment with the use of the electric current from a traction wire for heating and lighting his house and barn and for power. Mr. Smith has erected a power house and tapped the wires of the Indianapolis & Northwestern Traction Company. Motors of various sizes and kinds have been placed for the purpose of supplying light and heat, pumping water, operating the various farm appliances. Mr. Smith expects soon to add the necessary equipment to operate his plows, threshers and other farming implements.

RAVIA, I. T.—Franchises have been granted for a telephone system and an electric light plant.

FT. GIBSON, I. T.—Messrs. Brown and Rosecrans, of Joplin, Mo., are inerested in the construction of an electric light and power plant at Ft. Gibson.

OCHELATA, I. T.—The Town Council, at a recent meeting, granted a franchise to a company of capitalists from Chicago, who declare their intention to connect the towns in the oil field of Indian Territory by an interurban electric railway. It is proposed to have the headquarters in Ochelata, with lines running north to Tulsa and Bartlesville and east to Chelsea and Cleveland, Okla.

ALBIA, IA.—T. J. Baird, city clerk, writes that the citizens voted February 14 to grant A. R. Jackson a franchise to construct and maintain an electric light, heat and power plant.

AFTON, IA.—The Commercial Electrical Supply Company, of St. Louis, Mo., has secured the contract for constructing municipal electric light plant for $3,233. E. A. Lee, chairman of the Lighting Committee.

CRESTON, IA.—The City Council has passed an ordinance granting to the Des Moines, Winterset & Creston Electric Railway Company, subject to a vote of the people at the spring election on March 26.

CLAY CENTER, KAN.—It has been voted to grant a franchise to F. L. Williamson for an electric lighting plant.

OSAGE CITY, KAN.—Preliminary steps toward establishing an electric light plant have been taken by the city authorities.

HOLTON, KAN.—It is reported that estimates have been completed for water works and sewerage systems and an electric light plant, which place the cost at $89,000.

ARKANSAS CITY, KAN.—The rails for the Kansas, Oklahoma Interurban Railway have been contracted for. The road will be under construction by April 1.

LEAVENWORTH, KAN.—The present franchise of the Leavenworth Light & Heating Company will expire March 25, 1907, and the question of municipal ownership is now being agitated.

CHEROKEE, KAN.—An electric light and power plant is to be installed here shortly by private parties. It will furnish an all-night lighting service and will operate a day circuit for power purposes.

ANTHONY, KAN.—The Anthony Electric Company is installing an additional circuit and is considering other improvements in its plant, which will enable it to meet the increased demands for street lighting.

CHERRYVALE, KAN.—W. R. Murrow and A. E. Eads, of Peru, Kan., are installing an electric light and power plant in Cherryvale. The company will be known as the Murrow Electric Light & Power Company.

PAINTSVILLE, KY.—E. E. Maggard, of Morehead, writes that it is proposed to construct an electric light plant at Paintsville, at a cost of $30,000.

RUMFORD FALLS, ME.—The Rumford Falls Light Company is enlarging its plant and putting in new machinery. Chas. A. Mixer, the resident engineer, has the matter in charge.

PORT FAIRFIELD, ME.—A new elecric light company is being organized here. The new company will either buy power from the Presque Isle Electric Light Company or establish a steam plant at some convenient point in the village.

WOBURN, MASS.—In order to ascertain why electric lighting rates have increased in Woburn, Alderman J. H. Connolly is drafting an order asking for an inquiry into the matter. He proposes to recommend that a municipal plant be established, if possible, in conjunction with Wakefield and Winchester. The Woburn Board of Public Works is also interested in securing cheap lighting rates.

PITTSFIELD, MASS.—The plans of the Pittsfield Street Railroad Company's new power house are completed, and the specifications will be offered within a few days to the local contractors for bids by Messrs. P. J. & P. C. Dolan, through Engineer C. K. Stearns. The whole plant will cost not less than $125,000. Two vertical engines made by the Brown-Corliss Engine Company of Corliss, Wis., of 825 hp each, have been bought for $10,000 cash. These will be installed in addition to those already in use and will make a total of four power units.

DETROIT, MICH.—The power plant of the Detroit United Railways Company at Riopelle and Atwater Streets was slightly damaged by fire a few days ago. The loss is placed at not more than $5,000, but the damage was such as to compel the company temporarily to draw on its other plants for power.

WYANDOTTE, MICH.—The Pennsylvania Salt Manufacturing Company, Wyandotte, Mich., with head offices in Philadelphia, is one of the large salt producers. This company recently purchased a new power equipment to supplement the one already in use in order to meet the demands of increased business. The new units are a 36 x 48-in. simple, heavy-duty, Reynolds Corliss engine, direct coupled to an 800-kw, direct current Bullock generator. The engine will run in parallel with other units, and the load from the generator, which is of the engine type, will be used in part for light and power, but for the most part for electrolytic purposes. The entire unit, steam and electrical, will be furnished by the Allis-Chalmers Company, Milwaukee, and is expected to be ready for service early in June.

GIBBON, MINN.—It is reported that the Council is considering the issue of bonds for a lighting plant.

BRAINERD, MINN.—Ambrose Tighe, owner of the water works, has decided to construct a power plant on Crow Wing River.

SHAKOPEE, MINN.—A. K. Adams, superintendent of the city electric light plant, writes that the city may install a small generator direct-connected to engine

LITCHFIELD, MINN.—Emil Aveldson, superintendent of the village electric light plant, writes that it is intended to rebuild the street lighting system and install a new switchboard.

DULUTH, MINN.—The Mesaba Traction Company, which was recently incorporated, is making arrangements for the issue of $800,000 bonds with which to begin work. The preliminary survey for the line has been made and applications for franchises are pending before the councils of several of the towns. It is announced that if no delay is experienced construction work will begin in the spring.

AMORY, MISS.—The Amory Light & Power Company is making arrangements to duplicate its present plant next fall. Russell Miller is superintendent.

PLAINS, MONT.—M. H. Pierce and P. B. Jackson propose installing an electric light plant.

LIVINGSTON, MONT.—An election will probably soon be held to vote on granting a 35-year franchise to the Livingston Water Power Company to furnish electric light and power to the city.

CLINTON, MO.—The citizens are reported to have voted February 15 to issue $30,000 bonds for an electric light plant, and $70,000 for water works.

HIGGINSVILLE, MO.—The Higginsville water and light plant (municipal) will rebuild its lines this spring and will be in the market for a 60-kw, 60-cycle, alternating-current dynamo and also for fans and motors. Frank Monser is manager and superintendent.

DEXTER, MO.—The City Electric Light & Power Company, which is leased by the city to Arthur Sprinkle, is planning to erect new cedar

poles to take the places of the old cypress ones. A new engine will also be installed in the plant during the summer.

MORRISTOWN, N. J.—The Morris County Traction Company has applied for a franchise for an electric railway over Morristown streets.

TRENTON, N. J.—The Trenton, Hamilton & Ewing Traction Company has secured franchises for its Trenton Junction and Hamilton Square extensions.

FT. WOOD, N. Y.—Bids will be received by G. C. Burnell, Constr. Q. M., U. S. A., until April 16, for constructing an electric light and power system here.

UTICA, N. Y.—The Utica Gas & Electric Company has decided to increase the capacity of its electric generating plant on West Canada Creek at Trenton Falls and Prospect. M. Jesse Brayton is secretary.

HUNTINGTON, N. Y.—Supervisor Ireland and Charles E. Shepherd, of this place, are busy securing consents for the proposed electric railway between Huntington Station and Amityville by way of Melville and Farmingdale. This road is to be built by the Long Island Railroad Company.

NEW YORK, N. Y.—Plans have been filed for the great electric power station for the $4,000,000 terminal station of the Pennsylvania, New York & Long Island Railroad tunnel to be built opposite the passenger terminal on the south side of 31st Street, extending from Seventh to Eighth Aves. It is to be of granite ornamented with pilasters, and will be three and four stories high, with a basement cellar and subcellar. It will front 161.4 feet on the street and will have a depth of 98 feet. There will be an office floor, a floor for the electric fans and storage batteries, a floor for the economizer and coal bins, and a switchboard gallery. The designers of the power station are Westinghouse, Church, Kerr & Co., who estimate the cost at $300,000.

CHARLOTTE, N. C.—The Simons-Myrant Company of Charleston, S. C., has secured the contract for constructing a canal from the dam across Catawba River to the power house, about 1⅛ miles in length; probable cost, $75,000.

LILESVILLE, N. C.—Engineers Lockwood, Greene & Co., of Boston, Mass., write that the probable cost of the proposed development of Bluett Falls will be about $2,000,000. Bids for construction will probably be called for in two or three months.

CHARLOTTE, N. C.—The Southern Power Company is arranging to furnish the mills in and around Gastonia with electric power from its new station at Great Falls. The line will be built via the Old Catawba station, near Rock Hill, and Clover through Gastonia and on to the mills at Lowell and Belmont, the latter only eleven miles west of Charlotte. The main transmission line will be built of steel towers. Power will be transmitted at 44,000 volts, which will be stepped down in transformer sub-stations to working voltage. Contracts which warrant the construction of this line have already been made.

KENMARE, N. D.—The Kenmare Light & Power Company will install some new machinery.

WALHALLA, N. D.—J. F. Mager, proprietor of the Walhalla electric light plant, is contemplating increasing the boiler and generator capacity of the plant in the near future.

WILMINGTON, OHIO.—The Wilmington Water & Light Company is contemplating the purchase of a larger generator and will make extensions to its system during the summer. J. C. Martin is manager.

DAYTON, OHIO.—Cyrus E. Mead, general manager of the Citizens' Electric Co., writes that bids will be received about March 15 for the construction of an electric light, heat and power plant, to cost about $1,500,000.

ALLIANCE, OHIO.—The promoters of the Sandy Valley Traction Company, which proposes to build from Alliance to Canal Dover, has been obliged to change portions of its route because of the opposition of farmers who are asking exorbitant prices for right of way. The headquarters of the company are in Alliance.

CLEVELAND, OHIO.—The promoters of the Cleveland, Ravenna & Alliance Traction Company, which proposes to build from Alliance to Cleveland, announce that construction work will start in the spring. Locations for a power station and four sub-stations will be decided upon within a few days, the average distance between sub-stations being 12 miles. C. R. Morley and J. W. Holcomb, of Cleveland, are the chief promoters of the project.

RAINIER, ORE.—The City Council has granted W. P. Ely a franchise for an electric light plant.

ASTORIA, ORE.—The residents of Uniontown, Ore., are contemplating the erection of an electric lighting plant to be operated on the co-operative plan.

UNION, ORE.—The Central Railway of Oregon, which has made arrangements for an electric belt line throughout the Grande Ronde Valley, which has begun its permanent and final survey in Union.

FOREST GROVE, ORE.—The Haines Power Company expects during the year to treble the output of its plant, in which case considerable new machinery will be required. E. W. Haines is manager of the company.

PORTLAND, ORE.—The farmers of Eastern Multnomah and Clackamas Counties have organized for the purpose of introducing the rural telephone system. At the recent meeting of delegates W. H. Snashall, of Pleasant Valley, was elected chairman, and Theodore Bruegger, who lives near Gresham, was elected secretary.

BAKER CITY, ORE.—The Sumpter Electric Railway to the mining camp of Bourne is to be built this spring. W. E. Hurd, of Portland, and Anthony Mohr, of Sumpter, are in the east in the interest of the new road. It will be an electric line about ten miles long, serving one of the richest mining camps in the Northwest.

PORTLAND, ORE.—H. H. Newhall and Joseph M. Healy have filed a notice of their intention to apply for a franchise for an electric railway in this city. The franchise will also provide for the construction of bridges over Sullivan's Gulch. Mr. Newhall and Mr. Healy are respectively presidents of the East Side Bank and the Healy Investment Company

BEDFORD, PA.—The Bedford Electric Light, Heat & Power Company expects to install a 200-hp boiler soon. William Brice, Jr., is manager.

WILKESBARRE, PA.—Scranton and Wilkesbarre interests have applied to the City Council for a franchise here for a proposed electric railway to be built between Wilkesbarre and Nanticoke, a distance of 8 miles.

PITTSBURG, PA.—The directors of the Pittsburg & Alleghany Telephone Company have appropriated $750,000 for new construction and extensions during the coming fiscal year. President Splane submitted his annual report in which he showed a substantial gain in the number of new telephones installed and in the gross and net earnings. During the year about 55,000,000 messages were handled. The increase in long distance business was more than 200 per cent, as compared with the preceding year.

EDGEFIELD, S. C.—A movement is on foot at Edgefield to establish a water and electric lighting plant, and a mass meeting was recently held to consider the matter. The total estimated cost by experts is given at $51,000 for the water and lights. C. C. Wilson, of Columbia, has been appointed engineer.

ANDERSON, S. C.—The preliminary survey of the proposed electric railway between Anderson and Belton has been completed and it is announced that the work of construction will begin in the spring. The contract for steel rails has already been let.

WALHALLA, S. C.—The Oconee Water, Light & Power Company, of Walhalla, would like to correspond with parties for the financing of its project, or with a contractor to finance and construct. The company will supply water to Walhalla and West Union, and light and power to Walhalla, West Union, Seneca, Earley, Liberty and Central. The water plant is a gravity system, and there will be required piping, electric machinery, four 100,000-gal. tanks, etc.; a dam will also be built. The whole will involve an expenditure of about $200,000. The franchises for water and light are exclusive, and plants are exempt from municipal taxation during the life of the franchise, 50 years. All the power is already contracted for. James Thompson is secretary.

DEADWOOD, S. D.—The Consolidated Power & Light Company of South Dakota is contemplating the construction of 70 miles of power line. J. W. Springer is manager.

HURON, S. D.—A power plant for heating and lighting will be constructed at Huron College; it will contain one 50-kw generator and a 80-hp engine; also two 66x16-ft. boilers with accessories. J. J. Flather, consulting engineer, Minneapolis, Minn.

NASHVILLE, TENN.—The Nashville Railway & Light Company is discussing plans for a number of improvements in its system, which will probably be made during the present year.

BOLIVAR, TENN.—Bolivar is now prepared to test the advantages of municipal ownership, the electric light and water plant which has been in course of construction for some time, having been completed and turned over to the city.

STAMFORD, TEX.—J. H. Gintar is interested in the construction of an electric light plant.

YORKTOWN, TEX.—Franz Koenig, of Moulton, has decided to construct an electric light and ice plant.

MINEOLA, TEX.—The Mineola Light & Ice Company states that it will be in the market soon for a 75-hp producer-gas outfit. J. P. Kittrell is superintendent.

FORT WORTH, TEX.—Major J. D. Beardsley states that he has obtained a franchise from the City of Mineral Wells for the construction of six miles of electric railway.

AMARILLO, TEX.—The Amarillo Water, Light & Power Company is planning to install new machinery in its plant, consisting of a 225-hp engine, a 175-kw alternating-current dynamo and a 30-kw rotary converter. H. B. Jones, superintendent.

CLEBURNE, TEX.—B. F. Bond, of Jacksonville, Ill., and associates, have been granted a 50-year franchise for building an electric street railway over the residence and business streets of the city. The work is to begin within thirty days.

COALVILLE, UTAH.—The Council has decided to issue bonds for improving the electric light plant.

SALT LAKE CITY, UTAH.—O. C. Bluemel of Logan, Utah, has made an application for water from the Logan River for power purposes. His plant is to be of 150 hp. and the power to be generated will be used for driving machinery and for electric lighting about Logan.

WINCHESTER, VA.—The Winchester & Washington City Railway Company of Virginia has virtually closed a deal, it is said, for the pur-

chase of the plant of the Winchester Gas & Electric Company. The purchasing company is developing a large water power on the Shenandoah River in the State of Virginia, and, it is announced, will supply lights to Winchester and other towns beginning June 1.

GREENACRES, WASH.—The Spokane & Pend o'Reille Rapid Transit Company has a corps of engineers in the field locating the right of way for its proposed line from Spokane through the valley and on to the lake.

PORT ANGELES, WASH.—The city is at present considering a plan to use water power instead of steam for the operation of the municipal lighting plant, the capacity of which will probably be increased three fold. John Hallahan, manager.

SEATTLE, WASH.—In March the citizens will vote on the matter of issuing $600,000 for improvements in the municipal lighting plant, which will include an additional 1,200-kw machine, construction of a duplicate pole line, 5,000 cut-ins for commercial work, 500 arc lamps and 2,500 additional 6.6-amp. lamps. J. D. Ross, constructing electrician.

SPOKANE, WASH.—The Fremont Power Company is making arrangements to complete its power plant at the Red Boy mine near Olive Lake, which is expected to be ready for operation by next September or October. When the plant is completed it will be of sufficient capacity to furnish power for electric machinery and lighting at a number of mines in the upper camps as well as the Red Boy, and will be an important factor in the development of that section.

CLARKSBURG, W. VA.—The Bell Telephone Company is preparing for big improvements at once, which, when made, will place the company in a position to do a more extensive business and afford its patrons far better service. It is planned to install a new and larger exchange. These improvements are estimated to cost at least $20,000.

MARTINSBURG, W. VA.—The Martinsburg Power Company has applied to the County Court of Jefferson County for a franchise permitting it to erect poles and wires from dam No. 4 to Shepherdstown and Kearneysville for the purpose of transmitting electric power. The company expects to establish a large electric power plant at dam No. 4, which will furnish light and power to Shepherdstown and Martinsburg and will also provide power for the extensive stone quarries at Kearneysville.

ONALASKA, WIS.—The Wisconsin Light & Power Company is reported to have secured a franchise.

NEW LONDON, WIS.—It is expected that a 60-kw alternator and a high-speed engine will be installed in the city electric light plant next fall. H. C. Sterling is superintendent.

PLYMOUTH, WIS.—The Water & Light Board is planning to install in the city lighting plant this coming summer a new 72 x 18 horizontal tubular boiler. P. J. Douglas is superintendent of the plant.

SUPERIOR, WIS.—The Superior Water & Light Company is expecting to completely overhaul its plant this year and will purchase power from the hydro-electric plant of the Great Northern Power Company, of Duluth, Minn. B. F. Ellison ia general manager.

VANCOUVER, B. C.—Pacific Coast capitalists are planning to build an electric road from here to Portland, Ore., approximately 250 miles.

NEW WESTMINSTER, B. C.—The City Council and board of trade have combined forces to secure an electric railway to Millside, a distance of about 2 miles. Address Mayor Keary.

VICTORIA, B. C.—The British Columbia Telephone Company will shortly call for bids for the erection of a new central exchange here. The company will also install a new switchboard, with a capacity for 10,000 pairs of direct lines, at a cost of $100,000.

VANCOUVER, B. C.—A power company is being formed to generate 5000 electrical horse-power to supply the city with light and power. The aldermen are said to be in favor of commencing a civic lighting plant immediately. Address Mayor Buscombe or Alderman Odlum.

WINNIPEG, MAN., CAN.—The Winnipeg Electric Company has plans for a number of extensions around this city which will total over 20 miles. Wilford Phillips is general superintendent.

EDMONTON, CAN.—Members of the City Council have left for American cities to inspect various automatic telephone systems in use, and if their report is deemed satisfactory the Council will install an automatic system here. Address Mayor May or City Electrician Ormsby.

TORONTO, CAN.—The Allis-Chalmers-Bullock, Ltd., Montreal, has received an order from the Canadian Forty-Mile Gold Dredging Company, of Toronto, Can., for a special gold dredge equipped complete. The contract covers the electric light plant, two boilers, 100 hp each, engines, pumps, etc. The dredge will be ready for use early in May.

LETHBRIDGE, CAN.—A. J. Arnold, an attorney of Windsor, Ont., has applied for incorporation for the Alberta Northern Railway & Coal Company. The charter includes the power to build and operate a telephone line alongside the railway which will be built from this town to Edmonton, via Clagary and High River, a distance of approximately 500 miles. The charter also includes the power to make connections wherever desired en route.

CARBERRY, MAN.—The Council has applied for permission to issue bonds to the amount of $150,000 for the construction of an electric light plant. Mayor Eaton is chairman of the committee.

PORTAGE LA PRAIRIE, MAN.—It has been decided to issue $50,000 bonds for the purchase of the electric light plant, in which a number of improvements will be made. F. A. Whittaker is city clerk.

WINNIPEG, MAN.—The Bell Telephone Company will spend $750,000 in the Canadian Northwest this year on extensions and improvements to its local and long distance lines. Frank Patterson, Winnipeg, is district manager.

WINNIPEG, MAN.—The Winnipeg, Selkirk & Lake Winnipeg Railroad, now operated by steam, has been taken over by the Winnipeg Electric Company. The line will be electrified at once and many other improvements made. For further particulars address Wilford Phillips, Winnipeg, Man.

WINNIPEG, MAN.—The Canadian Pacific Railroad Company is making arrangements to connect its hotel in the Rocky Mountains by a copper telephone circuit, involving the stringing of 126 miles of wire. Work will be commenced in the spring. F. F. Busteen is assistant engineer.

WINNIPEG, MAN.—Surveys and plans are being rushed for the civic power plant which will be erected at Lac du Bonnet, and an effort will be made to have the plant completed to deliver power before the end of the year. Active construction will be commenced as soon as the weather permits in the spring. The power will be brought into this city by a 60-mile transmission line. H. N. Ruttan, city engineer.

WINNIPEG, MAN.—The Legislature recently appointed a committee to visit American cities for the purpose of inspecting various automatic telephone systems. The committee, after visiting Chicago, Ill., and Grand Rapids, Mich., rendered a very satisfactory report of its inspection, and it is probable that the automatic system will be adopted throughout the province and operated under the control of the government. Hon. Robert Rogers is minister of public works.

MAZATLAN, MEX.—An electric power plant to cost $500,000 is to be installed at the Guadalupe de los Reyes mines in this state. The order for the machinery for the proposed plant will be placed in the United States.

GUADALAJARA, MEX.—It is reported that negotiations are in progress for the consolidation of the electric light and power and street railway properties of La Electra, S. A., and the Compania Industrial de Guadalajara, of this city. Each company is offering to sell its holdings to the other, the price fixed by the Compania Industrial de Guadalajara for its interests being in excess of $2,000,000 gold. The two concerns control valuable water-power rights.

PORT ARTHUR, ONT.—Architect Aylesworth has completed plans for a $12,000 telephone exchange which the town will erect this year. City Clerk, J. McTeigue.

TEESWATER, ONT.—The Teeswater Electric Light Company intends to entirely reconstruct its lines and will install more arc lamps. W. H. Green, of Wingham, is manager.

KENORA, ONT.—The Board of Trade is endeavoring to interest capitalists in the construction of a street railway from here to Keewatin, a distance of about 17 miles. Address Mayor Horswill, Kenora, Ont.

OTTAWA, ONT.—The Canadian Pacific Railroad is planning to make experiments towards electrifying its branch lines in Eastern Canada. Address W. T. Tye, chief engineer, Montreal, Que.

HAMILTON, ONT.—The Hamilton Electric Terminal Company has made application to the City Council for permission to build a terminal station here for all electric lines running into the city. The cost is estimated at $250,000.

FORT WILLIAM, ONT.—A by-law has been passed by the taxpayers providing for a sum of $12,000 to be expended in improvements and extensions to the municipal telephone service. The sum of $15,000 has also been voted to be expended on the municipal electric lighting plant. Address Mayor Whalen.

BRANTFORD, ONT.—Brantford has scored a distinct point in the light and power deal with the Western Counties Power Company, which is seeking a 25-year franchise here. The company has agreed to waive the provisions of the Conmee Act, and hence the city will at any time be able to go into municipal lighting without purchasing the plant of the company.

MONTREAL, QUE.—The Montreal & Southern Counties Railway Company is seeking an entrance to Montreal by means of an electric railway, after having crossed the Victoria Bridge.

MONTREAL, QUE.—The Montreal Electric Street Railroad Company has decided to lay an additional 171 miles of track during the year, which will make its mileage 300 miles. The company estimates the total expenditure at about $15,500,000, including the cost of rails, power, rolling stock, real estate and equipment.

SASKATOON, SASK.—A. R. Campbell, Moosejaw, Sask., has been instructed by the City Council to prepare an estimate of the cost of installing an electric lighting plant.

DAWSON, Y. T.—Thomas O'Brien states that the Alaska Mines Railroad Company will build an electric line from here to Sulphur Springs, a distance of 30 miles.

Company Elections.

SAN FRANCISCO, CAL.—At the annual meeting of the Petaluma & Santa Rosa Railway Company on Feb. 6, the stockholders re-elected the present board of directors and they in turn re-elected the officers as follows: John A. McNear, president; J. W. Kelley, vice-president; Thomas Archer, secretary; Burke Corbet, treasurer and attorney.

CHICAGO, ILL.—At the annual meeting of the Chicago City Railway Company, held Feb. 16, a number of changes were made in the personnel of the company. The directors were re-elected as follows: John A. Spoor, chairman; A. J. Earling, Robert M. Fair, T. E. Mitten, Edward Morris, P. A. Valentine and Lawrence A. Young. The officers elected are T. E. Mitten, president; Mason B. Starring, vice-president and general manager; J. B. Hogarth, secretary and auditor; J. P. Burke, treasurer.

LONG ISLAND CITY, N. Y.—At the annual meeting of the Long Island Consolidated Electrical Companies, held Feb. 15, Messrs. Joseph F. Keany and W. G. Oakman were elected directors to succeed S. M. Prevost and W. F. Potter, both deceased. The other directors were re-elected.

LORAIN, OHIO.—At the annual meeting of the Black River Telephone Company the following named officers were elected: E. M. Pierce, president; William Honecker, vice-president; L. A. Fauver, secretary; H. E. Hageman, assistant secretary, and J. P. Preble, superintendent.

COLUMBUS, OHIO.—At the recent annual meeting of the Columbus Citizens' Telephone Company, the board of directors organized by electing Henry A. Lanman, president; John Joyce, vice-president; Edwin R. Sharp, secretary and treasurer; Frank A. Davis, general counsel; Gansey R. Johnson, general manager.

WAYNESBORO, PA.—The following officers were elected at the recent meeting of the Waynesboro Electric Light & Power Company; George B. Beaver, president; D. M. Wertz, treasurer, and H. B. McNulty, secretary.

PHILADELPHIA, PA.—The new board of directors of the United Telephone & Telegraph Company have elected the following officers: Richard G. Park, president; Edward Davis, vice-president, and S. R. Caldwell, secretary and treasurer.

PHILADELPHIA, PA.—At a meeting of the Board of Directors of the Atlantic Coast Electric Light Company, held in this city Feb. 13, the following officers were elected: S. F. Hazelrigg, president; George B. Cade, treasurer. J. G. Campbell will continue as superintendent.

PITTSBURG, PA.—At the annual meeting of the Pittsburg & Allegheny Telephone Company, the following directors were elected: J. G. Splane, John S. Weller, R. C. Hall, D. P. Reighard, J. M. Clapp, R. R. Binns, H. B. Beatty, George R. Webb, Ralph E. Flinn. The organization of the board resulted as follows: president, J. G. Splane; vice-president and general counsel, John S. Weller; treasurer, R. C. Hall; secretary and assistant treasurer, T. G. Davis.

NASHVILLE, TENN.—At the annual meeting of the stockholders of the Nashville Railway & Light Company, held in Nashville a few days ago, the following directors were elected: Percy Warner, J. H. Fall, F. O. Watts, Joseph H. Thompson, A. M. Shook, of Nashville, and A. H. Ford, J. K. Newman, S. H. March and George H. Davis, of New York. The directors met and elected the following officers: Percy Warner, president and general manager; J. H. Fall, vice-president, and N. P. Yeatman, secretary and treasurer.

WHEELING, W. VA.—The Ohio Valley Electric Light & Power Company has elected the following officers for the ensuing year: W. C. Handlan, president; John F. Frasher, general manager; William H. Snyder, secretary and treasurer.

LARAMIE, WYO.—At the annual meeting of the Laramie Electric, Gas Light & Fuel Company, R. H. Homer was re-elected president, Eli Cumrine, treasurer, and John H. Symons, secretary.

TORONTO, ONT.—The Electrical Development Company has elected the following officers: President, Sir H. M. Pellatt; vice-president, Fred Nichols; treasurer, D. H. McDougall; secretary, H. G. Nichols.

New Incorporations.

OAKLAND, CAL.—Articles of incorporation of the Coast Electric Company have been filed with the County Clerk. The directors are H. N. Turrell, George Turrell and Hugh Kimball. The capital stock is $10,000.

EATON, COL.—The Eaton Water & Light Company has been incorporated with a capital of $30,000, by William Atchison, C. D. Eggleston and others.

COLUMBUS, GA.—The Columbus Electric Company has been formed here to take over the following properties: the power plant and riparian right of the Columbus Power Company, the property of the Chattahoochee Falls Company, and that of the Coweta Power Company. The company will build immediately a 3,000-hp steam electric plant. G. Gunby Jordan and W. E. Bradley are named as directors of the company.

SPRING GROVE, ILL.—The Spring Grove Telephone Company has been incorporated with a capital of $10,000.

MATTOON, ILL.—The Coles County Telephone Company & Telegraph Company, with a capital of $100,000, has filed articles of incorporation. I. L. Lumpkin, W. G. Lumpkin and John McNutt, Jr., are the incorporators.

GREENVILLE, ILL.—The Bond County Telephone Company has been incorporated with a capital of $6,000. The incorporators are J. S. Bradford, E. E. Wise and George V. Weise.

COLFAX, ILL.—The Colfax Telephone Company has filed articles of incorporation stating its capital stock to be $15,000. The incorporators are William Gaddis, J. P. Arnold and F. J. Harris.

WATERLOO, ILL.—The Waterloo Electric Light & Water Works Company has filed articles of incorporation, with a capital stock of $25,000, for the purpose of constructing a combined water works and electric light plant. The directors are C. A. Wilding, W. J. Vesey and others.

CARBONDALE, ILL.—The Ohio & Mississippi Valley Telephone Company has filed articles of incorporation. The company is capitalized at $100,000 and will engage in the telephone, lighting and power business. J. B. Bundy, F. W. Willard and William H. Wardner are named as directors.

EAST ST. LOUIS, ILL.—The Southern Traction Company of Illinois has filed articles of incorporation. The line is to be constructed from East St. Louis to Millstadt, via Centerville, and from Centerville Station to Belleville, also from Millstadt to Belleville and easterly and southeasterly through St. Clair, Washington, Clinton, Randolph and Perry Counties. The principal offices will be located at East St. Louis. The capital stock is $2,500 and the incorporators and first board of directors are John Fouchette, Centerville Station; Henry C. Bogole, Belleville; W. E. Trautman, East St. Louis; F. P. Ernst and R. Vennon Clark, of East St. Louis.

SHIPSHEWANA, IND.—The Mutual Telephone Company has filed articles of incorporation. The company will receive bids for the construction of a telephone exchange, lines and equipment. David A. Plantz, M. S. Yoder and W. H. Weaver are directors.

INDIANAPOLIS, IND.—Articles of incorporation have been filed by the Columbus & Seymour Traction Company, which proposes to build an interurban road from Columbus to Seymour. The initial capital stock is $20,000, and the directors are F. P. Smith, C. S. Baker, R. O. Boyer, H. P. Hughes and H. M. Campbell It is the understanding that the work of building the road will actually be done by the Indianapolis, Columbus & Southern Traction Company, and that the new company will be taken over as soon as the road is ready to operate. The Seymour City Council has granted the Columbus & Seymour Traction Company a franchise, but this will in time be transferred to the Indianapolis, Columbus & Seymour Traction Company.

LACONA, IA.—The Lacona Telephone Company has filed articles of incorporation with a capital stock of $4,000.

DES MOINES, IA.—The St. Lucas Farmers' Telephone Company of Fayette County has filed articles of incorporation with the Secretary of State.

INDIANOLA, IA.—The Stony Point Telephone Company has been organized by some of the farmers in this vicinity. P. A. Millslagle is president of the company and J. W. Barnett, vice-president.

HUTCHINSON, KAN.—The People's Water, Light & Power Company has been organized with a capital of $50,000. It purposes constructing an electric light and gas plant, and later on, water works.

HUTCHINSON, KAN.—The People's Water, Light & Power Company has been incorporated and has applied for a charter. The capital stock is $50,000. It is proposed at first to build an electric light and gas plant and later ask the city for a franchise to build a water plant, in order to furnish the city and surrounding towns with water, light and power. The incorporators are also the directors of the Hutchinson Interurban Railway Company, the concern which will soon start the construction of an electric railway here.

PORTLAND, ME.—The De Forest Occidental & Oriental Wireless Company, a subsidiary concern of the American De Forest Wireless Telegraph Company has filed its certificate of incorporation. The authorized capitalization is $2,000,000.

CORINNA, ME.—The West Penobscot Telephone & Telegraph Company has been incorporated for the purpose of constructing and operating telephone and telegraph lines between Corinna and other villages in that section of Penobscot County. The company has a capital of $10,000 and the following officers: C. L. Jones, president, and J. T. Grey, treasurer, both of this city.

BALTIMORE, MD.—The Baltimore Electric Light & Power Company has been incorporated by Thomas J. Shryock, Summerfield B. Medairy, Alfred E. Booth, Robert M. Spedden and Peter E. Tome, all of this city. The capital stock of the company is said to be fixed at $250,000, but may be increased to $2,500,000. The company has heretofore been operated as a private concern.

BALTIMORE, MD.—William B. Turner, Joseph E. Henderson, Edward McIntyre, Charles R. Durling and Emory A. Craig have filed articles of incorporation for the Durling Electric Company, having a capital stock of $10,000. The corporation will manufacture, sell and install electrical machinery and devices.

JACKSON, MICH.—Articles of incorporation have been filed for the Cambridge & Woodstock Telephone Company, having a capital stock of $500.

LANSING, MICH.—The Michigan Power Company has been incorporated with a capital of $2,500,000, to operate the dams owned by the Platt Heat & Power Company, at Lansing, Dimondale, Grand Ledge and Eagle,

and further develop the water power at those places. A. A. and F. B. Piatt and Robert Ingersoll, of New York, are the promoters of the enterprise.

STARBUCK, MINN.—The White Bear Lake Telephone Company has been incorporated with a capital of $8,000.

DULUTH, MINN.—Articles of incorporation have been filed by the Mesaba Traction Company. The capital stock of the company is fixed at $50,000, and its officers are F. B. Myers, president; H. G. Seeley, vice-president; J. S. Hopkins, secretary-treasurer. All are residents of Biwabik.

CORINTH, MISS.—The Alcorn Electric Company has filed articles of incorporation, with a capital of $25,000. Among the incorporators are J. H. Jones and J. M. Boone.

BEATRICE, NEB.—The New Home Telephone Company has been incorporated and will erect a $20,000 exchange building.

CLATONIA, NEB.—The Farmers' Mutual Telephone Company, of this city, has filed articles of incorporation with the Secretary of State. The capital stock is $1,200, and B. C. Albert is named as one of the incorporators.

TRENTON, N. J.—The United Missouri River Power Company filed a certificate of incorporation in the office of the Secretary of State. The authorized capital stock is $5,000,000. The incorporators are B. R. Higgins, Samuel Hartman and E. G. Graves.

TRENTON, N. J.—The Mercer Electrical Company has filed articles of incorporation. The authorized capital stock is $100,000 and the incorporators are Francis C. Lawthrop, Robert R. Volk and Margaret T. Simpson. The object of the company is to generate and distribute electricity for heat, light and power.

RED HOOK, N. Y.—J. H. Sharpe, F. W. L. Fullerton, F. B. Sharpe and others have filed articles of incorporation for the Red Hook Light & Power Company, with a capital stock of $25,000.

EVANS MILLS, N. Y.—The North Country Telephone & Telegraph Company has been incorporated by Newton S. Beebe, Charles E. Paul and Emory E. Ward. The company has a capital of $15,000.

BROOKLYN, N. Y.—The Suttepec Electric Light & Power Company has filed articles of incorporation, with a capital of $200,000. A. F. Cole, Alexander Keogh and R. J. Heisler, of New York, are the incorporators.

TROY, N. Y.—A certificate of incorporation of the East Springfield Telephone Company has been filed. The capital stock is $10,000, and the directors include Henry Rathbon, S. A. Young, H. W. Young and O. R. Young.

ROCHESTER, N. Y.—The Rochester, Scottsville & Caledonia Railroad Company has been incorporated with a capital of $500,000 to operate an electric street surface railroad from Rochester to Caledonia. The directors are Henry C. Brewster, John N. Beckley, Merton E. Lewis, George C. Buell, Edmund Lyon and Charles T. Chapin, of Rochester, and others.

TOLEDO, OHIO.—The Forest Incandescent Lighting Company has been incorporated with a capital stock of $10,000, by A. L. Betz and E. A. Green.

FISHER, OHIO.—The Farmers' Telephone Company, with a capital of $2,500, has been incorporated by M. Dalton, R. M. Patterson, H. D. Hooper, Julian Gift and J. C. Harner.

NEW LEXINGTON, OHIO.—The Citizens' Independent Telephone Company has been incorporated with a capital stock of $50,000. J. B. Rhodes and T. J. Smith are among the incorporators.

LYONS, OHIO.—Articles of incorporation have been filed for the Lyons Mutual Telephone Company by Frank Denson, D. S. Knight, Eugene Carpenter, Charles W. Cassall, B. E. Pater and John Crow.

EDMOND, OKLA.—The Farmers' Mutual Telephone Company has been incorporated, with a capital of $5,000, by E. W. Wood, J. F. Paul, John McMullen, William Beresford and E. W. Childers.

PORTLAND, ORE.—The Forest Grove Transportation Company has been incorporated, with a capital of $10,000, by E. W. Haines, George G. Hancock, F. A. Watrous, George F. Naylor, J. E. Loomis and W. H. Hollis.

WAGNER, S. D.—The Farm & Home Telephone Company has been incorporated with a capital of $5,000.

ARMOUR, S. D.—Special articles of incorporation have been filed for the Chester Telephone Company, having a capital of $1,000. G. Fuhlendorf, Frank Grosebeck and Henry Bussell are the incorporators.

SAN MARCOS, TEX.—Articles of incorporation of the San Marcos-Luling Traction Company have been filed in the State Department. The company is capitalized at $500,000, and J. H. Jennings, R. C. Neighbors and C. R. Smith are named as directors.

SPOKANE, WASH.—With a capital of $1,000,000, the Inland Power & Electric Company has been incorporated for the purpose of developing water powers. The incorporators are Arthur Phillips, F. P. Walters and C. A. Lundford.

OLMPIA, WASH.—The Northwestern Long Distance Telephone Company, a California corporation, which has already filed articles of incorporation in Sacramento, has filed articles of incorporation under the laws of the State of Washington. Its principal office is at Los Angeles, Cal. The company has a capital stock of $1,500,000, and announces its intention to construct lines from Ashland, Ore., to Vancouver, B. C.

LADYSMITH, WIS.—The Ladysmith Light Company has been incomporated with a capital of $25,000 by C. A. Huffman, G. E. Newman and L. E. McGill.

BELOIT, WIS.—A consolidation of the gas, electric light and water companies have been completed. The name of the new company is the Beloit Water, Gas & Electric Company. Joseph L. Hendley, of Beloit, has been elected president, W. H. Wheeler, of Beloit, vice-president, and C. H. Wooley, of Cincinnati, secretary and treasurer. The new company is capitalized at $1,300,000.

MONTREAL, QUE.—The Central Light, Heat & Power Company, with a capital of $500,000, has been incorporated and will construct and operate a light, heat and power plant. The directors are Samuel Carsley, W. F. Carsley and Charles Morton.

MONTREAL, QUE.—The Grosvenor Electric Light & Heat Company has been organized here with a capital of $125,000, and will do a general lighting, heating and power business. The directors include J. W. A. Hickson, H. B. Picken and T. P. Howard.

THE RAILWAY ELECTRIC SIGNAL COMPANY, of Jersey City, has been incorporated by George Lande, Jr., L. B. Elkins, Jr., and Edward P. Coyne.

THE TELEPHONE SIGNAL COMPANY, of Alliance, has been incorporated by Binford T., William H., Arthur J. and Orlin Shreeve and Morris Taylor. The company is capitalized at $15,000.

TURBO-ELECTRIC CONSTRUCTION COMPANY, of New York, has been incorporated with a capital stock of $75,000, and the following directors: G. F. Archer, G. E. Hesse and W. D. Vanderbilt.

AMERICAN ELECTRIC WELDING COMPANY, New York City, with a capital of $500,000, has filed articles of incorporation. Maurice Lachman, Reginald Hawley and Joseph Solomon are named as directors.

UNITED STATES ELECTRIC PROTECTION & CONSTRUCTION COMPANY, New York, has been incorporated with a capital of $30,000 and the following directors: G. M. Treiber, R. C. Bennett and F. C. Bruckner.

H. C. K. COMPANY, of New York, has been incorporated and will manufacture electrical apparatus. The company is capitalized at $5000 and the following are named as directors: J. W. Holberg, P. H. Klein, Jr., and H. B. Coles.

THE BIDWELL ELECTRICAL COMPANY, of El Reno, Okla., and Chicago, Ill., has been chartered with a capital stock of $2,000,000. The incorporators are Benson Bidwell and C. W. Johnson, of Chicago, and H. L. Fogg, of El Reno.

THE AMERICAN ELECTRICAL NOVELTY MANUFACTURING COMPANY, of Jersey City, N. J., has filed articles of incorporation with a capital stock of $30,000. The incorporators are H. O. Coughlan, John R. Turner and H. Stafford Mantz.

THE CHEROKEE ELECTRIC & MANUFACTURING COMPANY, of Cherokee, Okla., has been incorporated with a capital stock of $25,000. J. W. Howard, A. J. Henderson, W. R. Ross, E. J. Dixon and L. G. Carpenter are named as the directors.

AUTOMATIC HEAT REGULATING & VENTILATING COMPANY, Newburg, N. Y., has filed articles of incorporation. It has a capital stock of $500,000, and the following are named as directors: F. C. C. Hadborn, M. J. Keogh and M. M. Keogh.

THE JAMES McNAUGHTON COMPANY, of Buffalo, N. Y., has been incorporated and will engage in the motor manufacturing business. The company is capitalized at $100,000, and James R. McNaughton, Charles S. Chamberlain and M. D. Ashford are named as directors.

INTERNATIONAL CLARK WIRELESS TELEGRAPH COMPANY, Augusta, Me., has filed its articles of incorporation. The authorized capitalization is $2,000,000. The stockholders are F. W. Parsons, Thomas E. Clark, W. E. Rogers, W. H. Gowan, M. A. Lafond, Frank Ford and Charles W. Thompson, of Detroit, Mich.

THE AUTOMOBILE COMPANY OF PATERSON, N. J., has filed articles of incorporation with the County Clerk. The authorized capital stock is $15,000, and the stockholders are Alfred B. Watson, Samuel J. Watson and Edwin M. Squires. The company's office is located at 217 Paterson Street. The building is to be renovated and enlarged, and a large amount of machinery and equipment for the manufacture and repair of all kinds of motor vehicles will be installed.

Legal.

TUNNEL STATIONS.—Chancellor Magie, sitting at Jersey City, has made permanent a temporary injunction restraining the Hoboken and Manhattan Tunnel Company from constructing a subway station under the trolley terminal station of the Public Service Corporation at Hoboken. The fight between the two companies has been going on since early in December. When the tunnel company's employes invaded the Public Service Corporation's property to begin operations they were arrested. Then the tunnel company, of which William G. McAdoo is president, secured an injunction restraining the Public Service Corporation from interfering with the tunnel company's employes, on the ground that

the tunnel company held a lease of the disputed property. At this point the Fidelity Trust Company of Newark came into the fight. This company secured a temporary injunction restraining the tunnel company from continuing operations, on the ground that the company is trustee for the bonds of the Jersey City, Hoboken & Paterson Street Railway Company, whose lines are now leased to the Public Service Corporation. The Fidelity Trust Company alleged that the construction of a tunnel station under the Public Service Corporation's terminal at Hoboken would damage the property and jeopardize the security of the bonds for which the company is trustee.

TRESPASS BY TELEPHONE.—At Boston, recently, the question whether a person may trespass by telephone was up for discussion before Judge Richardson in the Superior Court. A bill was brought by the Derby Desk Company and the Superintendent of its Somerville factory, George L. Holton, against his wife, Jennie H. P. Holton of Cambridge, who is living apart from him and who is said to have called him by telephone frequently. A demurrer by Mrs. Holton was sustained because Judge Richardson expressed the opinion that a husband could not maintain a bill against his wife, having taken chances on the things complained of in this case when he married the woman. The court thought, however, that the company could maintain an action for itself, and the husband's name was stricken out of the complaint. "I think one having a telephone in his house," said Judge Richardson, "could enjoin a person from continuously ringing him up day and night upon unimportant matters which he had no right to do, to the loss of sleep and rest to the occupant and to his great annoyance."

WISCONSIN TELEPHONE LITIGATION.—Attorney-General Sturdevant has started action against the Bell telephone interests in Wisconsin for the recovery of $500 provided for by Chapter 389 of the laws of 1905, to prevent one telephone company from charging a greater rental in one city than of like service in another city of the same class. The Wisconsin Telephone Company operates in some 30 cities of the State. The independents lobbied persistently during the last three sessions of the legislature for the passage of a bill to prevent discrimination. They charged that the Bell company would use unfair and ruinous competitive methods to drive out an independent company from a field, and then, after destroying the independent company, would make up the loss sustained on the competition by greatly raising the price for telephone service. The Bell people resisted the movement. Finally, in the session of 1905, a law was enacted classifying cities of Wisconsin according to size, and providing that any company maintaining exchanges in more than one place should charge the same price for like service in cities of the same class. It is for alleged violation of this law that the Attorney-General, upon the instigation of the independent companies, is proceeding. The offense alleged is the charging of higher rates in Beloit than in Janesville.

CHICAGO TELEPHONE RATES.—The U. S. Supreme Court of Illinois has handed down a decision against the Chicago Telephone Company in its refusal to meet the claims made on it by the city. The court has decided that the company has no right to charge more than $125 a year for a telephone or collect tolls within the city limits. The company has 6,000 telephones, it is estimated, for which it has been charging $175 a year, besides receiving large sums for telephone tolls. The decision will entail a loss of $50 on each of the 6,000 telephones for a period of three years, which makes an item of $900,000. The city claims the company owes it from $350,000 to $500,000 for compensation. The loss of tolls for connections with outlying stations, the payment of compensation to the city and the reduced telephone rate, it is believed, will cost the company $500,000 a year. Within a few years after receiving its franchise from the city the company began to install its "improved metallic circuit service" and make other improvements. On the ground that this improved service was not contemplated by the ordinance, the company added $50 a year for the use of telephones equipped for this service. The court holds that all territory annexed since the ordinance was passed is entitled to the same service and to the same rates as that portion of Chicago included within the city limits at the time of the passage of the ordinance. The decision says the improved service does not warrant an increase in the rate beyond the maximum fixed by the ordinance. It declares the provisions of the ordinance are general and apply to every kind of service. Nearly two years ago Comptroller McGann made a demand on the company to pay 3 per cent compensation on its business done outside the old city limits. The company made the same claim it urged in the quo warranto suit—that the ordinance of 1889 applied only to the territory within the city limits at that time. A suit for an accounting is now pending.

Educational.

TELEPHONY AT PURDUE.—The department of telephone engineering at Purdue University is now in the hands of Prof. Arthur Bessey Smith, who has been in charge since last September. The department is being enlarged and new apparatus installed. More new apparatus is in view, which, together with changes in the arrangement of the laboratories, will give better results than ever in teaching thoroughly the principles and practices of modern telephony. Special stress is laid on the necessity for a perfect understanding of fundamental principles, not the mere mastery of special cases. In addition to those specializing in telephony, every electrical engineering student is required to complete a typical experiment, which reveals to him a few of the features of the telephone.

Personal.

MR. CHARLES L. CORNELL has been elected secretary of the Niles-Bement-Pond Company in place of the late E. M. C. Davis. Mr. Cornell also fills the office of treasurer.

MR. THOMAS A. WAY, who has disposed of his interests in the Western Electric Telephone Company, of Mason City, Ia., has gone to Watertown, S. D., where he will be interested in the construction of railroads.

MR. M. NYMAN, formerly connected with the sales department of the Electric Applicance Company, Chicago, has been appointed manager of the Chicago office of the Buffalo Forge Company and the Buffalo Steam Pump Company.

BARSTOW & CHAMBERS.—The firm of Barstow & Chambers of Portland, Ore., and New York, has recently taken enlarged quarters, formerly occupied by the University Club, in the Failing Building, Portland. This firm has recently closed some important contracts for railways and power plants in the west.

MR. C. W. GEARHART, manager of the Syracuse office of the Crocker-Wheeler Company, has resigned recently, to the regret of the company and his colleagues, and has been succeeded by Mr. H. B. Hussey, formerly of the Stanley Company.

MR. W. H. WHITEHEAD, who has been manager of the New Heat, Light & Power Company, of Newark, N. J., since last spring, has resigned his position to take effect March 1. Mr. Whitehead will continue as manager of the city water works.

DR. LEE DE FOREST, inventor of the system of wireless telegraphy that bears his name, was married last week to Miss Lucile Sheardown, daughter of Mrs. M. T. Sheardown, of New York City. He and his wife sailed on the "Lucania" on Saturday for Europe.

MR. GEORGE F. BROCKMAN has resigned as superintendent of the Jackson, Ala., electric light plant, in order to go to Ensenada, Lower California, where he will superintend the building of a power plant and water works. Mr. Brockman superintended the building of the Jackson plant, and was its superintendent since it went in operation in 1904.

MR. R. D. SMITH, general superintendent of the St. Louis & Northern Railway Company, which is a part of the McKinley interurban system, has been appointed general manager of the Edwardsville Electric Light Company, the plant recently acquired from the local company. W. E. Owens, auditor of the railroad company has been appointed superintendent of the plant.

MR. G. A. NISBET, for several years with the General Incandescent Arc Light Co. and lately General Manager at the Chas. A. Thompson Co., New York, has taken charge of the New York branch of the Munder Electric Co., Springfield, Mass., manufacturers of incandescent lamps. The Munder Electric Co. is fortunate in securing the services of Mr. Nisbet, whose acquaintance in the electrical field is a very extensive one.

MR. J. E. FRIES has recently joined the selling organization of the Allis-Chalmers Company. He graduated from the Royal Technical College, Stockholm, Sweden, in 1898, and became connected with the General Telephone Company of that city. Later he engaged in electrical contracting in that city and during a period of four years carried out some large installations. On coming to this country he became connected with Westinghouse, Church, Kerr & Co., and worked on the Long Island Railroad electrification. He is now engaged with the Allis-Chalmers Company as a commercial engineer, located at present at the Cincinnati works, where he is familiarizing himself with the Bullock apparatus and manufacturing standards before joining the central headquarters at Milwaukee.

MR. B. S. JOSSELYN was recently elected president of the Maryland Telephone Company in place of Mr. D. E. Evans. Up to the time that Mr. Josselyn went to Baltimore he was general manager of the Union Terminal Railway Company at Sioux City, Iowa, and in the West has an enviable reputation as a successful manager. He was born on February 7, 1858, at Heyworth, Ill., and entered railway service in 1873 as ticket clerk. He served in a clerical capacity on various lines until 1893, when he became general manager of the Kansas City, Osceola & Southern Railway. This road was owned by Hon. John I. Blair, and while managing it Mr. Josselyn also operated various coal mines and looked after numerous farms and real estate holdings belonging to Mr. Blair. He constructed 40 miles of railroad through the brakes of the Ozark Mountains in Missouri, forming a connection with the St. Louis and San Francisco Railway, and was instrumental in the sale of the Kansas City, Osceola and Southern Railway to the 'Frisco Line. In January, 1899, Mr. Josselyn became general superintendent of the Omaha and St. Louis and Omaha and Kansas City and Eastern lines, and later was employed by Eastern capitalists as a railway expert to make reports on various properties. In February, 1900, he was appointed manager of the Kentucky and Indiana Bridge Railroad Company. A little over two years after taking the position he was selected to manage the Hudson Valley Railroad.

Obituary.

MR. GEORGE D. MACMILLAN, president of the La Crosse Gas & Electric Company, of La Crosse, Wis., died at his home in that city Feb. 12 of uraemic poisoning. Mr. MacMillan was 61 years of age at the time of his death.

Trade Publications.

HEATING APPARATUS.—The American Blower Company, Detroit, Mich., has issued illustrated sectional catalogue No. 186 describing "A B C" heating apparatus for the heating and ventilating of factory and public buildings and the drying of materials of all kinds.

HEATING PLANTS.—W. H. Schott, Marquette Building, Chicago, Ill., has issued an artistic poster directing attention to the Schott systems for central station heating plants, including the balanced column, hot-water system and the regulated vacuum steam system.

RAILWAY LINE MATERIAL.—The February blotter of the General Electric Co. is illustrated with a view of catenary construction, and is intended for directing attention to this company's line material. Leaflet No. 3420 is devoted to steel cutters for use on trolley wheels.

LIGHTING SPECIALTIES.—Flyer No. 2171 of the General Electric Company, Schenectady, N. Y., shows a complete line of fused ceiling rosettes for both 125 and 250 volts. Flyer No. 2173 of the same company deals with seamless outlet boxes for flush pocket switches and wall receptacles.

SWITCHBOARD INSTRUMENTS.—Bulletin No. 4429, of the General Electric Company, describes type R voltmeters and ammeters for use on switchboards. These instruments are constructed on the Thomson inclined-coil principle and are placed in heavy cast-iron cases to protect them from mechanical and magnetic disturbances.

ELECTRIC FANS.—Catalogue No. 17, of the Diehl Manufacturing Company, Elizabethport, N. J., is a neat publication dealing with ventilating fans for direct-current circuits. Illustrations and descriptions are given ceiling fans, electrolier fans, column fans, electrolier column fans, universal desk fans, telephone booth fans and counter column fans.

ELECTRIC HEATING DEVICES.—Booklet No. 3368, recently received from the General Electric Company, Schenectady, N. Y., gives a well-prepared description of household electric devices, including water heaters, milk warmers, cereal cookers, coffee percolators, chafing dishes, electric stoves, frying pans, flat irons, electric cigar lighters and luminous radiators.

DIRECT-CURRENT GENERATORS.—Bulletin No. 63 of the Crocker-Wheeler Company, Ampere, N. J., gives a complete and detailed list of direct-current engine-type generators now in use or on order. The bulletin gives the name of the company now operating the generator, the place where the generator is being used and states the rating of the machine.

GAS-ENGINE-DRIVEN ALTERNATORS.—The Crocker-Wheeler Company, Ampere, N. J., uses as an illustration for its first quarterly calendar for 1906 a view of a 4,000-kw C-W alternating-current generator. Three of these machines, which are stated to be the largest gas-engine-driven alternators ever built, will supply electricity for all of the trolley lines in San Francisco and vicinity.

THE AITON MACHINE COMPANY, 126 Liberty Street, New York City, has just issued its bulletin No. 2 describing its 8-drum stranding machine, which carries spools 12x8 in. at a speed of 200 r.p.m. The entire machine is mounted on a stiff bed plate, and is equipped throughout without gearing. Further details will be cheerfully given upon request at the company's office.

FAN MOTORS.—The Emerson Electric Manufacturing Company, St. Louis, Mo., has issued as catalogue No. 4220 an illustrated description of the 1906 Trojan fan for alternating-current motors. The motors operate on the induction principle, without brushes or commutators. Each motor is provided with a two-speed switch which allows the breeze from the fan to be adjusted to varying requirements.

ELECTRIC MINING MACHINERY.—Bulletin No. 11 of the Jeffrey Manufacturing Company, Columbus, Ohio, contains a well-prepared article by Mr. F. L. Sessions, on "The Application of Electricity to Mining." The article is profusely illustrated, numerous views being given of electric locomotives in service, electric coal cutting machines, electric pumps, electric hoists, electric drills, electric generating equipments and switchboards.

HIGH-PRESSURE BLOWERS is the title of Bulletin No. 127 of the Sturtevant Co., of Boston, Mass. In condensed form it presents the essential features of this type of rotary or so-called positive blower, tabulates the proper sizes required for different capacities of foundry cupolas, gives the principal dimensions of horizontal and vertical types and illustrates methods of driving by direct-connected Sturtevant motors and engines.

ELECTRICAL SPECIALTIES.—Catalogue No. 16 of Pass & Seymour, Solvay, N. Y., clearly and comprehensively illustrates a complete line of electrical specialties in which the major insulating material is porcelain. All unnecessary descriptive matter has been eliminated, but the devices are well illustrated and much information is given concerning them. Price list No. 83, of the same company, shows the rates at which the specialties may be purchased.

COAL-HANDLING MACHINERY.—Pamphlet No. 061 of the C. W. Hunt Company, West New Brighton, New York, is issued as an introduction to the general line of machinery manufactured by this company. Although the pamphlet is of vest pocket size and consists of only 24 pages it contains illustrative and descriptive matter relating to almost all types of coal handling machinery and auxiliary devices in addition to industrial railways and electric locomotives.

TELEGRAPH CODE.—F. B. Badt & Co., 1504 Monadnock Block, Chicago, have issued a concise pocket telegraph code which will doubtless be welcome to the electrical profession and trade in general, as most of the codes now in existence are either too bulky or do not meet necessary requirements. Each code word contains at least five words, and are so selected that an error in one letter will usually not make the word unintelligible.

CURVE-DRAWING INSTRUMENTS.—An illustrated blotter recently received from the General Electric Company, Schenectady, N. Y., shows a record made by a curve-drawing voltmeter in addition to view of the instrument itself. This line of curve-drawing instrument includes ammeters, voltmeters, single-phase and polyphase wattmeters. These instruments have high torque with minimum friction and are unaffected by stray magnetic fields.

TRANSFORMERS.—The February bulletin of the Pittsburg Transformer Company, Pittsburg, Pa., gives an illustrated description of furnaces used for annealing the sheet steel cores of Pittsburg transformers. The furnaces are fired with natural gas through high-power Bunsen burners. The February calendar of this company is one of the prettiest of an exceedingly beautiful line of monthly reminders which the company sends to its friends.

OIL SWITCHES AND CIRCUIT BREAKERS.—Bulletin No. 7 of the Hartman Circuit Breaker Company, Ohio, describes and illustrates oil switches and circuit breakers for high-potential circuits. These switches are designed for single-phase, two-phase and three-phase systems and for any voltage or capacity. Views are given of single-throw and double-throw, three-pole switches and of remote controlled oil circuit breakers for potential of 45,000 volts.

INCANDESCENT LAMPS.—The Buckeye Electric Company, Cleveland, Ohio, has issued a striking folder entitled "Under the Gates of Babylon." The folder contains a well-executed illustration of ancient Babylon, beneath which is a cut of a modern "Buckeye" lamp. After giving a word picture of the siege of Babylon, the description concludes as follows: "And, the weird, mysterious hand-writing appeared on the walls—and there arose the words which have been echoed through time, 'Better Buy Buckeye.'"

FEED-WATER HEATERS.—Catalogue No. 6 of the Alberger Condenser Company, 95 Liberty Street, New York, is devoted to Wainwright feed-water heaters, expansion joints, heat extractors and air coolers. The Wainwright "Evenflow" heater is provided with corrugated tubes which disturb the feed water and give to it a tumbling motion, constantly bringing fresh particles into contact with the walls of the tube and thereby increasing the conduction of heat through the metal to the water.

VENTILATING FANS.—The American Blower Company, Detroit, Mich., has issued an illustrated circular designated as "miniature No. 67," which deals with disc ventilating fans. Among the views are several showing compact equipment, each consisting of an electric motor direct connected to the shaft of the fan. One of the illustrations shows the motor placed upon a substantial base, the guard of the fan being mounted on the frame of the motor, resulting in a combination of exceptional rigidity and compactness.

THE SPLICING OF WIRE ROPE.—The John A. Roebling's Sons Company, Trenton, N. J., has issued an extremely well-prepared pamphlet, presenting a description of the method of wire-rope splicing as employed in its shops. The instructions are accompanied with illustrations from photographs taken during the splicing of a one-inch diameter regular lay rope, with six strands and a hemp center. This pamphlet, which may be obtained upon request, should prove of much value to any having to deal with the splicing of wire rope.

HYDRAULIC JACKS.—Catalogue No. 68 of the Watson-Stillman Company, 46 Dey Street, New York, is a 91-page publication relating to hydraulic jacks. The head and interior tube or ram of the jack form a reservoir from which the filling flows to the pumps, and to which it is returned in lowering. From the pump it is forced, by the downward stroke of the piston, past the lower valve into the cylinder, and this being closed at the bottom, the ram rises to allow space for the water. The catalogue is well illustrated throughout.

HEAVY DUTY ENGINE.—The heavy duty horizontal engines manufactured by Allis-Chalmers Company may be seen in operation in so many public and private power plants that few who desire to investigate their construction need have recourse to a descriptive bulletin. One, however, is shortly to be issued for the convenience of prospective customers, and this will naturally embody the latest features of design. The bulletin will appeal not only to engineers in charge of power plants, but also to the owners who may not have much information concerning technical details of operation, yet can understand "results."

OIL AS FUEL.—Chas. C. Moore & Co., 63 First Street, San Francisco, Ca., has issued as a treatise "On the Economy of Steam Power Plants Using Oil Fuel," reprints of articles which appeared in the *Journal of Electricity, Power and Gas*. The descriptive matter is accompanied by twenty tables dealing with such factors as cost of labor per kw-hour, cost of plant per kilowatt, etc. The publication should prove extremely valuable as a convenient reference for any one interested in oil as fuel. The possibilities which lie in the use of oil for this purpose will be appreciated when it is known that a barrel of oil which contains 6,216,000 B.t.u. may be purchased for from 40 cents to $1.50.

PRICES OF COPPER.—An interesting little folder has just been issued by the Wire & Telephone Company of America, Rome, N. Y., giving the monthly average price of copper from 1883 to 1906. The highest price reached was 19 cents per pound in 1905, while the lowest price was 9⅛ cents per pound in 1894.

ALTERNATING-CURRENT GENERATORS.—While direct-connected alternators have largely displaced belted machines in modern power stations, there are many places, particularly in comparatively small installations, where belted units are called for. Belted machines are easily connected to the existing source of power, as for example, a line shaft used for driving other machinery; and for these installations of lesser size they are lower in first cost than direct connected apparatus. The Bullock machines described in a bulletin just issued by the Allis-Chalmers Company, of Milwaukee, are adapted to a wide range of output.

THE VEHICLE EQUIPMENT CO., Long Island City, N. Y., manufacturer of automobiles for all purposes, has just issued a very handsome oblong catalogue devoted to its specialty—electric vehicles. Of these for industrial uses alone it has made not far short of a thousand in the last four or five years, and the demand grows all the time. The industry deserves to be fostered by the central stations as a new field of current supply, and this is seen by some of them already, notably the New York Edison Company, which employs 50 in its own service. The Vehicle Equipment Company in this catalogue illustrates a great many types, and quotes a number of testimonials, showing how efficient, enduring and economical the electric vehicle really is when properly built.

VARIABLE-SPEED MOTORS.—In bulletin No. 4430 of the General Electric Co. are shown two curves illustrating the cutting speeds used and the time required to face a 72-in. cast-iron disc when the lathe was driven by an electric motor with field control and when driven by belt from a counter shaft, respectively. The electrically-driven tool accomplished the work in 53 per cent. of the time required for the other tool. These tests indicate that one man operating a lathe driven by an electric motor of the variable-speed type can do almost the same amount of work in the same time as two men operating two lathes driven through stepped-cone pulleys. This bulletin describes a complete line of variable-speed motors for use with machine tools, and shows numerous illustrations of the motors and their controllers. Flyer No. 2172 of the same company is devoted to speed-controlling rheostats for use with variable-speed shunt or compound wound motors, particularly adapted for use with motors driving machine tools.

News of the Trade.

THE CANADIAN GENERAL ELECTRIC COMPANY, of Toronto, is planning to build a plant at Rossland, B. C., for manufacturing electrical supplies.

THE EWING-MERKLE ELECTRIC COMPANY, of St. Louis, Mo., has filed a statement increasing its capital stock from $50,000 to $150,000. One-half of the increase has been paid in.

THE BAY STATE LAMP COMPANY, of Danvers, Mass., very naturally is satisfied with its business during 1905, since the increase over 1904 was nearly 70 per cent, while the present outlook is equally encouraging.

NATIONAL-ACME MFG. CO. has taken new quarters for its offices and warehouses in the Edgcomb Building, Clinton, and West Washington Streets, Chicago, and with offices at 56 West Washington Street. A large stock will be carried.

DOSSERT & CO., manufacturers of wire and other connections, etc., have moved to their new factory and offices at 242 West Forty-first Street, New York City, where they will enjoy larger facilities, and will increase their production, being thus enabled to make prompt deliveries of all such apparatus.

MOORE TUBES.—The Moore Electrical Company has issued a new and revised edition of its booklet on vacuum tube lighting by the system of Mr. D. M. Moore. This inventor has been slowly and steadily pushing his way and now has over a thousand feet or more of tubes in commercial use "and miles in immediate prospect."

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Conn., now has its commodious and modern factory in full operation. The growth of the concern, which necessitated a larger and better equipped plant, has been rapid and substantial.

THE BRYANT ELECTRIC COMPANY, of Bridgeport, Conn., has awarded the contract for the erection of a $25,000 addition to its plant. The structure will be of brick, three stories high, with basement, 60 x 122 ft., and will be electrically equipped.

THE DIEHL MANUFACTURING COMPANY has recently leased the entire building at 1305 Race Street, Philadelphia, Pa., for use as a warehouse, and a much more complete stock of apparatus of all kinds will be carried. The large increase of the business of the Philadelphia office of the company has made this action necessary. The office still remains at 1217 Filbert Street.

ELECTRIC STORAGE BATTERY CO.—We are advised by the Electric Storage Battery Company of Philadelphia, with regard to the recent elaborate description in our pages of the equipment of the Public Service Corporation of New Jersey, that the 600-amp. battery at Orange for railroad feed is of its construction, as well as the 700-amp. battery at Paterson for incandescent lighting service; and the 1,000-amp. 500-volt power battery at Mechanics Street. These were all made and installed by the company.

GENERATING SETS are now manufactured by the B. F. Sturtevant Co., Boston, Mass., in a line of 36 sizes ranging from 3 to 100,000 kw, direct connected. The vertical cross-compound engines were designed to meet the rigid specifications of the U. S. Navy Department, which in the case of the 100-kw demand a consumption of 31 pounds per kw-hour. These engines, as well as the vertical and horizontal simple engines, are entirely enclosed, provided with forced lubrication and watershed partitions. The generators are multi-polar, capable of carrying 50 per cent momentary overload and 25 per cent excess for two hours without sparking or undue heating. The smaller sizes of these sets are adapted to service as boosters.

THE UNDER-FEED STOKER COMPANY of America, general offices, Chicago, announces the opening the first of the present month of its New York office, Mr. B. S. Lachlan, manager, at 930 Bowling Green Building, 11 Broadway. As the purchasing departments of so many large concerns controlling plants in various parts of the country have their headquarters in New York City, and because of the large number of consulting or advising engineers practicing in New York, it is absolutely necessary that inquiries from this section should have the personal attention of a representative. Previous to coming with the company, Mr. Lachlan was connected with the purchasing department of the American Can Company, and enjoys a large acquaintance among purchasing officials generally, as well as the engineering profession. It is expected that Mr. Lachlan will receive the same consideration upon re-entry to his former field, as when looking after the Under-Feed Stoker Company's interests as manager of its former office in Boston.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED FEBRUARY 13, 1906.
[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N.Y.]

812,183. TELEGRAPH KEY; William O. Coffe, Cleveland, O. App. filed Jan. 11, 1904. In order to facilitate the transmission of Morse code messages the patentee makes use of a short pendulum vibrating between contacts. The movements of the pendulum are controlled by a lever whereby it may vibrate to transmit dots, or be held to produce dashes as required.

812,184. THERMAL PROTECTOR AND ALARM; Frank B. Cook, Chicago, Ill. App. filed Dec. 18, 1902. A combined thermal protector and lightning arrester having the usual spaced carbon blocks, and having spring fixtures organized therewith which tend to separate and break the circuit, but which are normally held together by the usual thermal cartridges.

812,196. APPARATUS FOR MEASURING ELECTRIC RESISTANCES; Sydney Evershed, Streatley, Eng. App. filed Feb. 27, 1904. A resistance box, including a generator and a particular form of volt meter which is not influenced by the stray field of the generator. For this purpose the voltmeter includes two specially arranged movable coils both of which vibrate in a very strong permanent field.

812,236. JACK CORD DISTRIBUTER; Benno Salzmann, Berlin, Germany. App. filed Nov. 16, 1905. Details of a distribution switchboard of a telephone exchange.

812,279. AUTOMATIC ENGINE STOP; Nathaniel C. Locke, Salem, Mass. App. filed Apr. 10, 1905. An arrangement for closing an engine throttle by an electrically-operated trip. A form of needle valve is spring-tensioned to open a passage behind a piston which effects the closing of the engine valve, but the needle valve is normally constrained against such movement by an electro-magnet.

812,287. TEST CLAMP; Theodore Bagel, Chicago, Ill. App. filed Dec. 19, 1904. A clamp for temporarily connecting a number of wires of different sizes. Includes a series of loosely mounted plates which are pressed together by a screw, and serve to engage the wires between their parallel faces.

812,433. ELECTRIC RAILWAY SIGNALING SYSTEM; Charles Mitchell and Harry Millinger, East St. Louis, Ill. App. filed Aug. 8, 1903. Details of a signal system including semaphores provided with a special form of eccentric and catch. Includes a train stop for setting the air brakes on the train in case the signal is disregarded.

812,436. SYSTEM OF CALIBRATING RECORDING WATT-HOUR METERS; Douglas P. Morrison, Newark, N. J. App. filed June 17, 1905. A system of calibrating a watt-hour meter which consists in providing a standard meter whose field coils are in circuit with each other and in circuit with the mains leading from the source to the load, a potential circuit for the standard meter and the meter to be tested leading to the mains, and a switch interposed in the potential circuit of the standard meter.

812,445. MULTIPOLAR ELECTROMAGNET; Hermann G. Pape, New York, N. Y. App. filed May 17, 1904. A U-shaped magnet, the intensity of which can be regulated. Each leg consists of an ironclad magnet, the central pole of which can be advanced or retracted with respect to the outside rim or casing.

812,491. TELEPHONE SWITCH PLUG MECHANISM; Adolph C. Gilgen, Passaic, N. J. App. filed Nov. 25, 1904. A switch plug mechanism having a plug at its conical end and a contact spring having a portion disposed in the path of and constructed to engage said plug frictionally when the same is moved in one direction, and to act upon the conical end of said plug to complete its return movement.

812,504. PRIMARY BATTERY; Charles E. Lockwood and George A. Lutz, New York, N. Y. App. filed July 18, 1904. A battery element comprising a perforated retainer containing a depolarizer and having a binder soluble in battery liquid for preventing such depolarizer from passing through the perforations in the retainer.

812,505. PRIMARY BATTERY; Charles E. Lockwood and George A. Lutz, New York, N. Y. App. filed July 16, 1904. A battery comprising a liquid holding jar, a perforated retainer therein, a depolarizer in the retainer, a zinc between the retainer and the wall of the jar, a caustic solution in the jar and a binder applied to the wall of the retainer, closing the perforations therein, said binder being soluble in said solution and of a character to not materially effect the electrical efficiency of the battery.

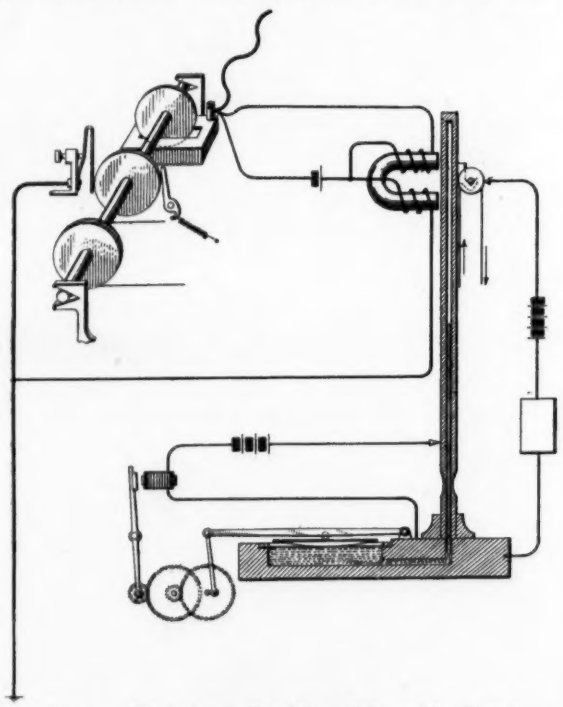
812,557. METHOD OF RECEIVING TELEGRAPHIC SIGNALS; Stephen D. Field, Stockbridge, Mass. App. filed June 10, 1905. A universally tuned receiver for syntonic wireless messages. In order to be able to pick up wireless messages which are tuned to any particular frequency, whatever that frequency may be, patentee provides a mechanical vibrator which receives the impulses from the detector circuit. The mechanical vibrator as means by which its periodicity is constantly changing so that it is bound to pass through the frequency of any messages during some portion of the cycle of its change. When resonance occurs in this way, the vibrator is made to continue in the particular resonating relation.

812,561. OVERHEAD LINE; Emile Giraud, Paris, France. App. filed Oct. 31, 1903. In order to avoid destructive effects by the breakage of a high potential wire, the latter is supported by a hinged arm, the movement of which when the wire breaks is effective to harmlessly ground the conductor or connect it to another circuit.

812,573. AUTOMOBILE; Hermann Lemp, Lynn, Mass. App. filed June 9, 1904. A tricycle as a single motive wheel with a special arrangement of differential gearing for driving the same, including two sprocket chains respectively connected to an engine and motor and to a generator. The relation is such that the generator absorbs the energy on down grades, and a storage battery assists by driving the motor on hills, etc.

812,597. RAILWAY TRAFFIC CONTROL SYSTEM; William Rowe, Marrickville, N. S. W., Australia. App. filed Feb. 23, 1905. A block signal system, including contact plates along the track by means of which the various semaphore signals are operated, and telegraphic communication had with the various stations along the route under certain circumstances.

812,607. INDUCTION COIL; John Splitdorf, New York, N. Y. App.



812,557.—Method of Receiving Telegraphic Signals.

filed Nov. 15, 1904. The core of the induction coil is provided with longitudinal ducts or passages for the purpose of ventilation and an external air space or jacket is provided around the core to further promote the cooling and ventilation thereof.

812,609. ELECTRIC HEATER FOR LIQUIDS; George E. Stevens, Lynn, Mass. App. filed July 19, 1904. Details of a portable heater for liquids comprising a vessel having a central chamber containing a heat coil, the wires of which pass outward through the handle of the device.

812,611. RHEOSTAT; Fred L. Stone, Schenectady, N. Y. App. filed July 25, 1904. The resistance element is disposed in a series of concentric rings having their extremities alternately joined so as to form one continuous conductor. The regulating arm has blocks moving in the annular spaces between the rings so as to short circuit portions of the elements.

812,657. ELECTRIC COIL; Isidor Kitsee, Philadelphia, Pa. App. filed Sept. 10, 1904. A method of making magnet coils and similar bobbins the essential feature of which is to wind bare wire with insulating layers of unvulcanized rubber, and then vulcanize the whole into a compact spool.

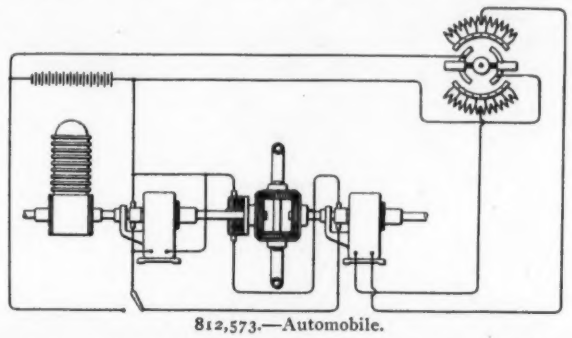
812,700. RHEOSTAT; George E. Stevens, Lynn, Mass. App. filed Oct. 12, 1904. A pair of resistance coils are disposed in parallel relation and the regulator arm has blades which swing over the bare resistance wire so as to cut in or out portions thereof.

812,710. PORTABLE ELECTRIC LAMP OUTFIT; Arthur Wilson, Berlin, Wis. App. filed Mar. 28, 1905. Includes a box casing having a number of battery cells therein and a supplemental housing including a lamp and a coil of flexible cord.

812,718. TELEPHONIC REPEATING SYSTEM; Adolpr J. P. Bertschy, Woodstock, Ill. A repeating system comprising an electro-magnet connected in a receiving circuit, a transmitter for controlling currents in the sending circuit, a vibratory diaphragm common to said electro-magnet and said transmitter and an auxiliary switching device controlled by said diaphragm to cause the closure of a break in the sending circuit.

812,725. SURFACE CONTACT SYSTEM; Frank E. Case, Schenectady, N. Y. App. filed July 22, 1904. Separate generator is located on a train and driven by the air pressure system. This generator serves to furnish current for operating the connection of distributing circuits along the track to energize sections or plates as the train passes along. The separate generator is also used for supplying light and heat to the train.

812,726. LOCKING DEVICE FOR AUTOMOBILES; Alexander Church-



812,573.—Automobile.

ward, New York, N. Y. App. filed June 30, 1904. Relates to an automobile driving mechanism of the form set forth in patent No. 812,573. In this case the patentee provides a mechanical arrangement for locking the generator armature to its field frame as an emergency device in case of the differential clutch arrangement should fail.

812,733. POLICE SIGNALING APPARATUS; Charles L. Foster and Peter K. Higgfins, Los Angeles, Cal. App. filed July 14, 1904. Details of a police signaling apparatus having circuits including the various police boxes operated by the opening of the doors and the insertion of keys therein.

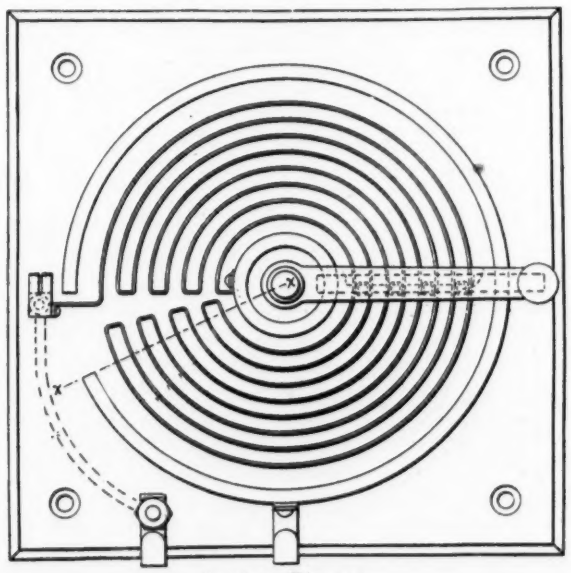
812,766. ELECTRICAL ROSETTE; James A. Mabane, South Boston, Va. App. filed Apr. 30, 1904. Relates particularly to the wire attaching means which comprise metallic clips having their ends bent into an S-shape so as to embrace the wire between the convulutions thereof.

812,773. TELEGRAPH INSTRUMENT; Carl J. Schwarze, Adrian, Mich. App. filed May 31, 1904. The relays are wound with a separate coil or winding forming a closed circuit, the purpose of which is to take the extra current due to the fall of magnetization, and prevent sparking at the contact points.

812,776. AUTOMATIC FIRE ALARM; Alfred Taylor, Victoria, Canada. App. filed May 13, 1905. The push buttons of a call bell system are constructed with a pair of flexible diaphragms forming an air chamber. In case of fire the expansion of the air closes the circuit independently of the button.

812,781. ELECTRICALLY CONDUCTIVE RAIL JOINT AND BOND THEREFOR; Bancroft G. Braine, New York, N. Y. App. filed Apr. 11, 1904. The fish-plates have V recesses therein to engage the rail bases. The engaging surfaces have strips of copper inset therein which are pressed together when the fish-plates are clamped into place and constitute bonds.

812,700. ELECTRIC RAILWAY SYSTEM; William N. Haring, Nyack, N. Y. App. filed Oct. 31, 1903. Relates to an underground conduit system having a sectional conductor, the sections of which are spring-pressed upward. When the car passes they are depressed by the



812,611.—Rheostat.

collector shoe, and temporarily charged by contact with the potential source.

812,791. MOTOR CONTROLLER; Wiley E. Houston, Santa Ana, Cal. App. filed June 14, 1905. In order to avoid a burn-out of motors employed for driving pumps due to temporary failures of the line current, the patentee provides a circuit breaker operated by a check valve in the water pipe so that in case of stoppage the circuit cannot be again completed without proper manipulation.

812,797. INSULATING ATTACHMENT FOR ELECTRIC FIXTURES; Adolphus A. Knudson, New York, N. Y. App. filed Mar. 8, 1905. A flexible jacket for electric lamp fixtures to guard against shocks in case the fixtures become grounded.

812,801. ELECTRIC FURNACE; Julius E. Ober, Schenectady, N. Y. App. filed July 15, 1904. An electric furnace comprising a tubular heating member, a sheath therefor of titanium carbid and a packing of finely divided, heat-resisting material surrounding said sheath.